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# The Bamboos of the Malay Peninsula

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## Scope of the present work

THE BOTANICAL classification of bamboos, as of other members of the grass family, is based on characters of the inflorescence, flowers and fruits. Botanists have accordingly described and named flowering specimens. In some cases such botanists never saw the living plants, and were not provided with information which would have permitted them to prepare descriptions useful for the field botanist.

A field botanist finds that most of the bamboo plants which he sees have no flowers. Therefore he often cannot name the plants by consulting the botanical descriptions. But he finds that by careful study of vegetative organs, particularly of culm-sheaths, he can learn to recognize different kinds of bamboos with certainty. This is the kind of knowledge possessed by the Malays who use bamboos in many ways every day of their lives.

Thus there are two classes of information about bamboos, and in order to gain a satisfactory understanding of these plants the two classes of information must be combined and correlated. The object of the present work is to combine and correlate such information of these kinds as is at present available concerning the bamboos of Malaya. An introduction is needed to explain the nature of the characters which may be used to recognize and to describe bamboos, because such a statement is not readily available elsewhere; and, as will appear in the course of this introduction, it appears to the present writer that a radical re-examination of the basic ideas of the botanical classification of bamboos is long overdue, so that botanically the following statement is an attempt to formulate revised concepts, not merely a summary of previous knowledge and opinions. A more detailed statement on the same subject has been published in the journal *Phytomorphology,* Vol. 6, pp 73–90.

The first botanist who made an effective attempt to study the bamboos of Asia in the field was Kurz, who travelled widely in Java and later in Burma. He recognized the importance of culm-sheaths in the recognition of bamboos, and was the first to describe and illustrate culm-sheaths for diagnostic purposes; his important published works date from about 1864 to 1877. Gamble extended the work of Kurz to cover, so far as he could, all the bamboos of India, Burma and Malaya, and produced his monograph in 1896, as volume 7 of the *Annals* of the Royal Botanic Garden, Calcutta. Gamble knew a great many Indian bamboos in the field, but he did not visit Malaya, and therefore his descriptions of Malayan bamboos were made upon the basis of specimens collected by others, usually lacking culm-sheaths. Ridley later made considerable collections of bamboo specimens in many parts of Malaya, and recognized the existence of several species not known to Gamble, but his descriptions of these are very unsatisfactory, both as regards vegetative and flower characters, so that the account of Malayan bamboos in his Flora, Vol. 5, is not only unreliable but almost unusable by anyone who has not Ridley's own specimens available for study. Backer wrote a most valuable work on the grasses of Java (*Handb. Fl. Jav.,* part 2), giving detailed descriptions in Dutch of all the bamboos found there; I have found this work very helpful, and was fortunate in being able to supplement it by examination of bamboo plants in cultivation in the Botanic Garden at Bogor in Java in the year 1951.

The account of bamboos in the present work is mainly based on a study of the specimens and writings of Gamble and Ridley, as preserved at Singapore and at Kew (also on some earlier works, especially of Munro), and on my own observations of bamboos in the field in various parts of Malaya and in cultivation in Singapore. I wish to express my thanks to the Director of the Royal Botanic Gardens, Kew, for permission to use the relevant specimens, manuscript notes and publications in the herbarium and library at Kew, and also to Mr. C. E. Hubbard for placing his unique knowledge of the family Gramineae at my disposal.

I have attempted to describe the bamboos occurring in Malaya, as far as they are known at present, in terms of the species concept, based on the work of former authors. But, as will appear, I am by no means sure of the limits of species in some cases, and I think it likely that there are some hybrid swarms which cannot be treated in the conventional way, and which cannot be understood without a good deal more field work. The present treatment is therefore a tentative one, and will need revision. But I hope at least it will be a useful basis on which further work can be established.

To the botanist, bamboos are of great interest in many ways which have no immediate relation to the everyday usefulness of the plants. But I believe that the establishment of a better understanding of the inter-relationships of bamboos (i.e., of their basic botanical classification) is of considerable ultimate practical importance. The practical man, who is interested only in discovering the useful kinds, and in exploiting their particular virtues, may think that much of the present work is irrelevant for his purpose. But the first thing a user of bamboos needs is the ability to distinguish one kind from another; and the second thing is the need of names which have a definite meaning. This work attempts to supply these needs, so far as is at present possible, along with its contribution to a more fundamental study of the plants.

Bamboos are used in so many ways by village people in Malaya that they may be described as a necessity of life. Even in this mechanical age their usefulness continues, and is likely to continue; and it may well be that the peculiar properties of bamboos may even find new uses for modern needs. A survey of the usefulness of the particular kinds of bamboos found in Malaya is long overdue; but such a survey must be dependent on a study by which the various kinds of bamboos can be distinguished. The present work is a contribution to that necessary study, and I hope it will be a stimulus to the undertaking of the further necessary practical work, which may be of great importance to the well-being of many people in Malaya. The subject is however an intricate one, and its study cannot be undertaken as a spare-time job; it needs the undivided attention of a specialist, considerable equipment, and an adequate experimental plantation.

A recent publication by F. H. Hildebrand on the use of bamboos in Java is frequently quoted in the present paper. The full title of this publication is: *Aanteekeningen over Javanese Bambu-sooten* (Rapport van het Bosbouwproefstation, Bogor, no. 66. 1954).

The illustrations which occur in the text are all original, with the exception of figs. 9C and 10B (adapted from Arber: Gramineae), and fig. 12. The drawings of culm-sheaths were mostly made by Mr. Chan York Chye, formerly artist at the Botanic Gardens, Singapore. For some other drawings of vegetative parts of plants I am indebted to Mr. J. N. Milsum. All drawings of spikelets and their parts were made by myself. For permission to reproduce fig. 12 (originally published in the Kew Bulletin) I am indebted to H.M. Stationery Office, London.

## The occurrence of Bamboos in Malaya

In Malaya, bamboos are common everywhere, but they never dominate the landscape. In the extreme north of Kedah and Perlis, there are small areas of forest consisting almost entirely of bamboos, but these are not comparable to the extensive bamboo forests found in the monsoon region further north. In the equable climate of Malaya the gregarious flowering of single species of bamboos in particular areas, at more or less regular intervals of many years, which is such a striking phenomenon in India, does not normally occur, and my impression is that the truly native species of Malaya can go on growing indefinitely, flowering sporadically from time to time or in some cases flowering a little almost continuously. After an unusually heavy flowering, a plant may die back for a time, but I have no evidence that this occurs gregariously. Notes on the flowering behaviour of individual species, so far as known, are given under each species in the main body of this work.

The bamboos of Malaya can be divided fairly clearly into village or cultivated bamboos and native or forest bamboos. A few native species may also be planted, or at least encouraged, in the neighbourhood of villages, but there are certainly some village bamboos which are not native. The same situation occurs in Java, where the species of Gigantochloa, well known as village bamboos, are apparently not native. The distribution of Gigantochloa in Malaya gives some support for this last statement. I have seen no native plants of that genus in southern Malaya. The first appears in the neighbourhood of Tampin (at the southern end of the Main Range) and as one travels northwards the variety of native Gigantochloas increases. In the north of Kedah this variety is quite bewildering, and I believe that hybrid swarms exist. It is fairly clear that the main centre of distribution of Gigantochloa lies north of Malaya, probably in Lower Burma, where no intensive study of bamboos has been made. So that the Gigantochloas of Java, and some planted in Malaya, probably came from the Burma region, and may be interesting records of the migrations of men; but in the absence of a good knowledge of the bamboos of Burma those records cannot be interpreted. It is strange that the most distinctive and most useful Gigantochloas of Java seem hardly known in Malaya (*G. apus* and *G. maxima*).

The native bamboos in Malaya are especially seen on the edges of forest (beside roads made through the forest, and beside rivers), on steep hillsides, and in clearings. They are nearly all light-demanding plants, and cannot grow strongly in the shade of high forest. Such bamboos are extensively used, as for example in the local industry of basket-making (to serve the needs of vegetable growers) near the road from Tapah to Cameron Highlands. Local users carefully discriminate the kinds of bamboo best suited to their needs, whether for house-building (posts, walls and floors), basket-making, raft-building, food, etc., but there has been no systematic planting of bamboos of the most useful kinds, nor any attempt at selection among allied species, such as occurred in Java, except the plantation of *Dendrocalamus asper* by Chinese market gardeners for its edible shoots. There would seem to be considerable scope for the study of the bamboos native in the northern part of Malaya, for selection of the best species or varieties (which could be propagated vegetatively) and for the introduction of some other species from neighbouring countries. It is said for example that *Gigantochloa apus* is of outstanding value in Java, but in Malaya it is not a common village bamboo; I have only seen it at the Federal Experiment Station at Serdang, and at the Botanic Gardens, Singapore (apparently imported by Javanese employed in the Gardens).

There are some bamboos which cannot grow effectively in isolation, because their culms are not strong enough to bear the weight of their branches. Such bamboos only grow in forest, and their development is encouraged by a little clearing such as has occurred in the making of roads into the mountains; the most conspicuous examples are *Dendrocalamus pendulus* and *Schizostachyum grande,* both very abundant in the foot-hills of the Main Range. A remarkable species of very restricted distribution, occurring at higher elevations, is *Bambusa wrayi.* Young culms of these bamboos, being slender and unbranched, grow vertically upwards, bending later with the weight of lateral branches, which rest on any trees which may be near enough. There are also a few species which are even more dependent on the support of trees, and might be called climbers, namely *Dinochloa scandens, Bambusa pauciflora* and the peculiar species I have called *Racemobambos setifera.* The growth-habits of these plants have never been adequately studied.

Most bamboos, including all village bamboos and those which form dense clumps on the edges of forest, have rigidly erect culms, the upper parts often curving outwards or the slender tips drooping. The culms usually grow quite close together, and only branch from their upper nodes. There are a few species which branch from the lower nodes, notably the thorny bamboos, in which these spreading lower branches bear stiff thorns. The general aspect of such a clump of a particular species, like the general aspect of a tree, is something one learns to recognize without analysing its individual characteristics; and in fact it is difficult if not impossible to express clearly in words the peculiarities of habit which distinguish different kinds of bamboos. In particular, the precise way in which the group of branches at each upper node develops, which must be a characteristic feature of every bamboo, is difficult to observe clearly and has in fact been little observed. Though the process will not be easy, I believe such observation may be of considerable interest.

There are however characters which can be more easily observed and more clearly defined, and the next section will deal with these characters. To understand them one must describe in some detail the way in which a bamboo plant is constructed, and the way in which it grows. After the description of the vegetative parts of the plant will come a description and discussion of the flowering parts.

## Vegetative characters of Bamboos

**Rĕbong.** A new bamboo culm grows from a bud at the base of an old culm. This bud grows slowly at first, forming the rudiments of all the parts of a fully developed culm, as it were in a contracted condition. This slowly developing young shoot is called a rĕbong by Malays (fig. 1). It consists essentially of a short massive little-differentiated stem packed with food-materials and protected by numerous two-ranked overlapping rigid sheaths. When this development is complete, the rĕbong may rest for a time, until rainy weather provides the stimulus for further growth; but in Malaya probably such resting often does not occur. Well grown rĕbong are cut for use as food (bamboo-shoots).

The more rapid growth of the rĕbong into a fully developed culm begins slowly, accelerates until the culm is about half its full height, and then slackens gradually in rate; the maximum rate of increase in length is about 30 cm. (one foot) per day in some bamboos. The growth consists in the elongation of the very short internodes present in the rĕbong and the consequent sliding of the sheaths (which are attached to the whole circumference of each node) within each other. The sheaths also expand somewhat and become rigid, so that they can support the internodes, which need to remain in a soft condition while they are elongating; the final stage of elongation of an internode is confined to its basal region, which is entirely enclosed and supported by the sheath when the upper part of the internode is fully exposed and has begun to develop its rigid mature condition.

**Rhizome, roots and culm.** The basal nodes of the new culm remain close together, near the surface of the ground (or even below the surface) and this part of the culm also needs to grow a little horizontally so that the new culm may be able to grow up clear of the previous ones. The horizontal part of the new growth bears roots and is called a rhizome. In some bamboos (e.g., species of Arundinaria, not in Malaya) the rhizome continues to grow horizontally for an indefinite length, the upright culms formed by lateral buds upon it; but in all Malayan bamboos the apex of each piece of rhizome soon grows upwards to form a new culm. The collective rhizome of a Malayan bamboo is thus formed by the first part of the growth of each new culm, and is said to be sympodial (fig. 1).

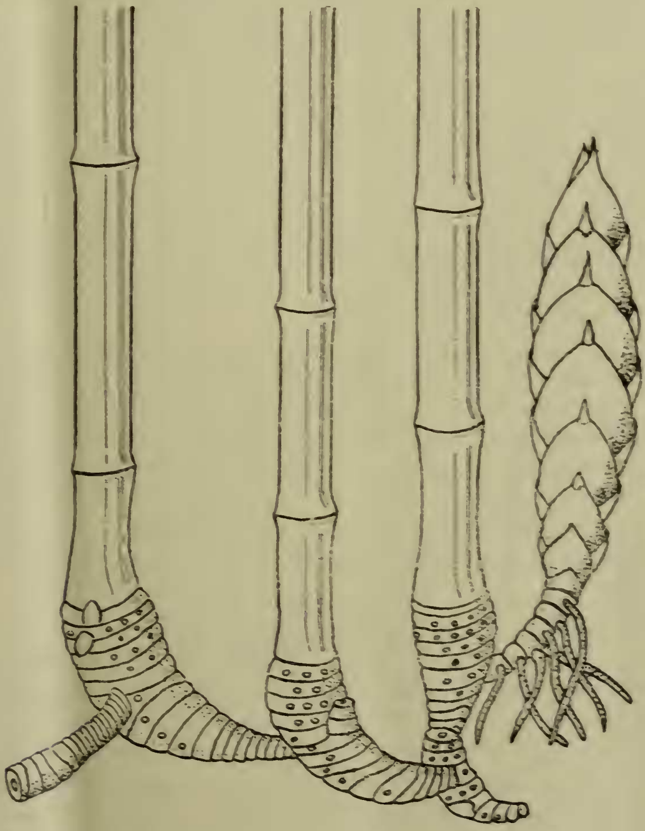

Fig. 1. Bases of three old culms, showing root-bearing rhizome of short internodes at base of each, and a new shoot (rebong) beginning growth. Diagrammatic; all sheaths removed except on new shoot.

Roots begin to form at the nodes of the new piece of rhizome (breaking through the bases of the sheaths) as soon as the new culm begins to grow rapidly, and soon serve to provide its needs from the earth (though the early stages of growth are of course dependent on the roots on older rhizome-lengths). This sympodial arrangement ensures that each new culm will have its own new roots to supply its needs. Sometimes the first few nodes of the erect part of the culm also bear roots (notably in *Dendrocalamus asper*); whether such roots will grow beyond the stage of rudiments probably depends on how much moist organic material (dead leaves, etc.) is present round the base of the plant.

The young culm grows to its full height before branching. At this stage the culm-sheaths cover the lower part of each internode, and the upper part of the internode is exposed between the top of the sheath and the next node. The exposed parts of the internodes of young culms are sometimes covered with a waxy powder (how this develops, and what is its nature, seem to have been little investigated) and sometimes they bear more or less abundant stiff hairs, usually appressed, variously coloured. The waxy powder and the hairs disappear as the culms become old, and can only be seen clearly on young culms; these characters may be of considerable importance in recognizing species. The sheaths also lose their diagnostic characters as they become old; they are described in a separate section below.

The maximum diameter of culms, the thickness of their walls (in the middle of an internode), the length of the longest internodes, the prominence or otherwise of nodes, are also important characters; these can best be noted from old culms. Young plants, or plants growing under poor conditions, have smaller culms than mature and well-grown plants of the same kind. It is sometimes not easy to judge whether one is dealing with a young or impoverished plant, or with a distinct species which never attains a larger size.

**Culm-sheaths.** These are modified leaves, and have the same parts as leaves, but the parts are differently proportioned and of somewhat different structure (figs. 2 and 3). The important part functionally is the sheath, which is large and rigid and protects the growing culm which develops within it. The sheath is attached at a node, the width of the base of the sheath being actually greater than the circumference of the node, so that the two sides overlap towards the base (the sheath is never tubular). When the sheath is old, it usually separates from the node, leaving a scar. The back of the sheath is usually covered with rigid hairs which are either appressed or loose; in either case they are easily detached from the old sheaths and are irritant when in contact with the softer parts of one's skin, so that the study of sheaths is not always a pleasant experience. The colour of the hairs is characteristic, and sometimes a waxy powder is produced along with them. The inside of the sheath is always smooth and shining. The colour of those parts of young sheaths not covered by hairs is also characteristic.

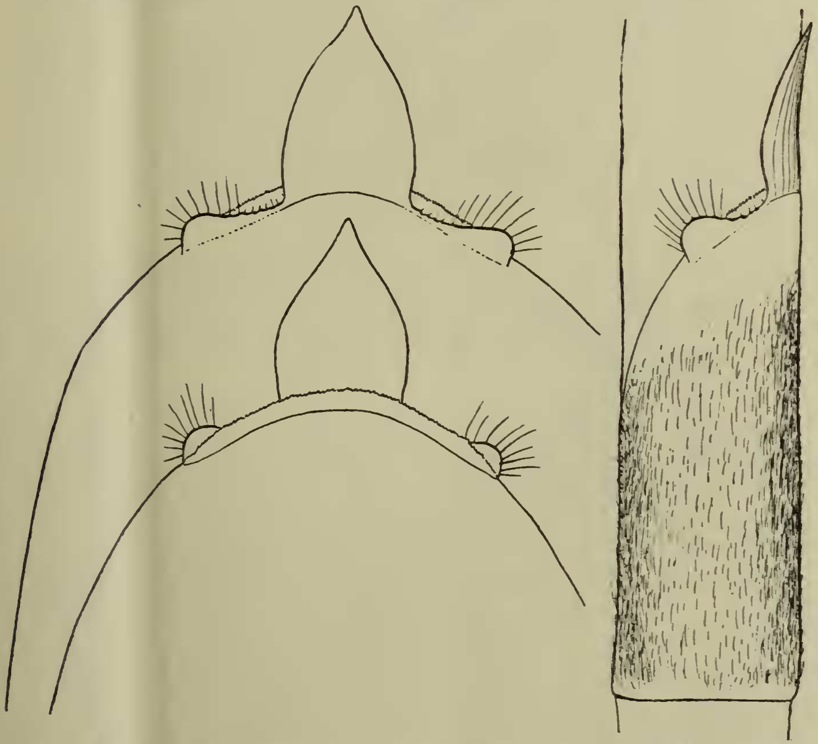

Fig. 2. On right, generalized drawing of a culm-sheath in natural position; the blade is erect, the auricles have bristles, and the ligule a serrated edge. On left, the same culm-sheath spread out flat, the upper drawing showing the outer face, the lower drawing the inner face with complete view of ligule.

The sheaths are always in two opposite ranks, alternating. The top of a sheath is more or less narrowed, and carries the blade (called by Gamble the imperfect blade). The line of junction of sheath with blade is usually quite distinct (in a few cases it is not detectable externally), and when the blade is old it usually breaks away more or less cleanly along this line. The line of junction is sometimes almost horizontal, but more often it is upcurved, the middle highest.

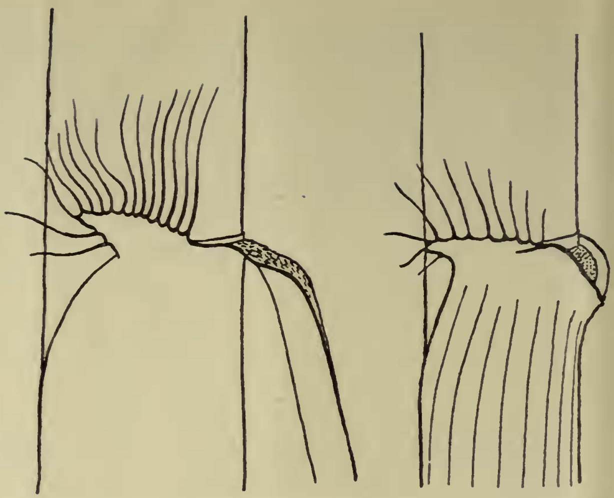

Fig. 3. *Schizostachyum longispiculatum.* On right, top of old leaf-sheath from which the blade has fallen, showing leaf-scar (dotted) surrounded by callus, with ligule and auricle, × 4; on left, top of a small culm-sheath, the blade reflexed, its base joined laterally to the auricle, × 1½.

The blades of sheaths at the base of a culm are quite small; on the sheaths near the top of the culm they are leaf-like and green. There is thus not one unique shape and size for a culm-sheath blade on any bamboo. Blades on sheaths at about eye level or a little higher (say 150–200 cm. above ground) have well developed blades which are usually rigid and quite different in character from the ordinary leaves, and it is these blades which are usually described, because they show the best diagnostic characters. Such blades have a characteristic shape (broadly or narrowly triangular, or elongate), texture and colour; they are either erect or spreading or reflexed; they usually have hairs (pale or dark) on their upper surface (fig. 4).

The blade of a culm-sheath is usually contracted a little just above the base, and then the base itself spreads out along the top of the sheath to the full width available, or sometimes beyond the full width. Thus there are extensions of the blade-base on each side of the blade proper, and these extensions may be enlarged towards their outer ends, the ends sometimes spreading and ear-shaped. These lateral extensions of the base of the blade are called auricles (little ears) and their characters are very important diagnostically; their shape, size, colour, and the presence or absence of bristles on their edges. The auricles are sometimes no more than a low firm rim to the top of the sheath not occupied by the blade (e.g., in species of Gigantochloa); in other cases, where the triangular blade occupies the whole of the sheath-top, the auricles are more or less rounded free lobes on each side of the base of the blade. The auricles are not deciduous like the blade, but they are often fragile and are broken as the sheaths become old, or at least they lose their bristles, so that old sheaths never show the auricle-characters satisfactorily.

The ligule is an upgrowth from the top of the sheath on the face towards the culm. This upgrowth is in contact with the culm, and goes right across the inside of the base of the blade. The ligule is always much thinner than the sheath itself, and sometimes quite fragile. Its height, and whether it is entire or lacerated, or whether it bears a fringe of fine hairs, are the characters which need to be observed. The ligule is close to the auricles at its ends,

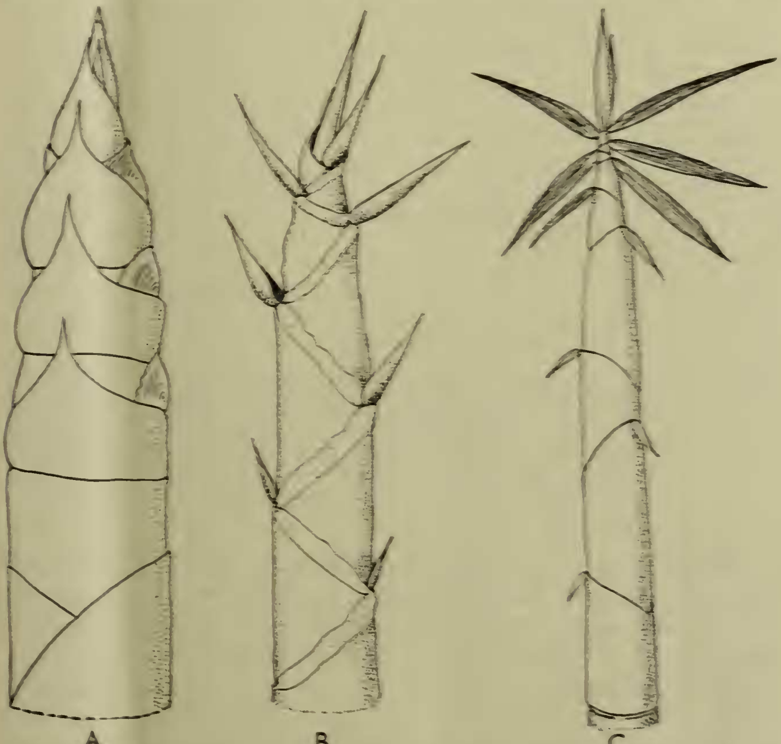

Fig. 4. Tops of young growing culms, to show differences of shape and position of blades. A, *Schizostachyum zollingeri* (blade rigid, erect, broad, convex); B, *Dendrocalamus pendulus* (blade rigid, narrow, partly reflexed); C, *Gigantochloa scortechinii* (blade green, leaf-like, spreading or reflexed).

but it is always quite separate from the auricles. Careful observation is often necessary to distinguish between the bristles on the auricles and bristles or hairs on the ligule. The ligule can only be seen clearly on sheaths removed from young culms.

**Branching and foliage leaves.** Under every sheath on the main culm is a bud, enclosed in a flat sheath of its own; the sheath backs on to the culm itself, and has two inflexed edges which embrace the inner parts of the bud (fig. 5). Along the two sharp keels so formed are usually stiff hairs, which may be diagnostically important; they have been insufficiently studied in Malayan bamboos. This two-keeled sheath is called a prophyll, and is actually the first leaf on the branch of which the bud is the rudiment. Such a two-keeled prophyll is normally present at the base of every branch in the grass family (and in some other families of Monocotyledons).

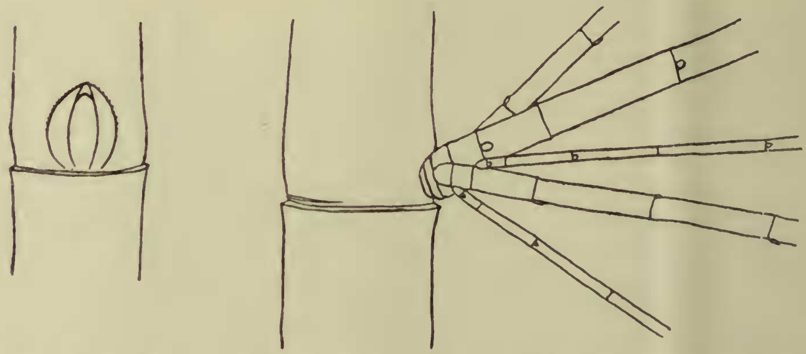

Fig. 5. On left, bud at node on a culm (sheath removed), showing prophyll with inflexed edges enclosing inner sheaths of bud (keels of prophyll bearing short hairs). On right, Diagram to show arrangement of branches at node of a culm; all sheaths removed and lower internodes somewhat elongated. The plane in which buds lie on any branch is at right angles to that of the branch which bears it.

When the culm has reached its full height, the main lateral buds begin to grow and to form branches (they usually remain dormant at the lower nodes, though always present). Each branch has at first very short internodes, like the culm itself, and then longer ones; the thickness of the branch is naturally much less than that of the culm. Usually one or more secondary branches grow from the lower nodes of each main lateral branch, and the process may be repeated on these secondary branches, so that from each node will appear to come a tuft of small branches (fig. 5). The larger of these branches may also bear some more small branches at nodes further from the base. There is a leaf at every node, but the lower leaves consist of sheaths only, or have very small blades; where the internodes are short, the sheaths overlap, and the stem itself is not seen. The length of the branches, and whether they spread or droop, may be characteristic features, but have been little observed.

The ultimate branchlets are leafy, and usually not very long, bearing perhaps 8–12 leaves. The internodes are shorter than the leaf-sheaths, usually much shorter. The first few leaves on a branchlet consist of short sheaths only. The blade of the first foliage leaf is usually smallest (sometimes short and broad), and has a broadly rounded base; the uppermost leaves are also often a little smaller than the middle ones, and have usually a narrowly cuneate (wedge-shaped) base. Each leaf-blade has a stalk; the upper leaves usually have the longest stalks. For descriptive purposes, one should take the middle leaves on a branchlet, noting any peculiarities of the uppermost or lower leaves.

The leaves on the branches from the upper part of a large culm are usually fairly uniform, and they are always smaller than the leaves on sucker shoots (i.e., branches growing from nodes near the ground, and more or less shaded); a young plant may also have larger leaves than an old one. Thus in one species there may be a considerable range of leaf-size; and a dried specimen may not be a representative sample, because it may merely have been from the branch most accessible to the collector. The top of a main culm, which becomes gradually thinner upwards, also bears foliage leaves, and so there is a transition between culm-sheaths and foliage leaves on one single stem. The transition from a rigid brown culm-sheath blade to a green leaf-like blade sometimes occurs quite low down (e.g., in some species of Gigantochloa), sometimes only quite near the top of the culm (*Schizostachyum zollingeri*).

The blades of all leaves on a branchlet lie almost in a single plane (unless the branchlet stands erect); that is, they are all twisted at the base through a right angle, the twist occurring in the stalk. This twisting is often accompanied by asymmetry of the base of the blade and unequal development of the auricles.

A further asymmetry of the blade is caused by the fact that bamboo leaves are rolled up while they are developing in the bud. The blade on one side of the midrib is rolled inwards, that on the other side of the midrib being wrapped round on the outside. The inrolled half of the leaf-blade is always a little wider than the other half, and its main veins are usually more widely spaced; its edge also is usually almost smooth (except near the tip), whereas that of the outer half is rough, bearing short stiff oblique teeth consisting of single cells with thickened walls; these teeth are like a fine saw and can easily cut one's fingers. (The leaves of some other families of Monocotyledons are similarly rolled in the bud, and show a similar kind of asymmetry; e.g., members of the Banana and Ginger families).

Bamboo leaves have longitudinal veins like ordinary grass leaves. There is always a pronounced midrib, and the rest of the blade has evenly spaced main veins with several smaller veins between adjacent main veins. The veins are close together and are usually raised on the lower surface in dried leaves. In the non-Malayan genera Phyllostachys and Arundinaria there are distinct cross-veins uniting the longitudinal veins, exactly as in the Malayan forest grass Leptaspis. In other bamboos, especially those with the smaller veins very close together, cross connections between the veins are less distinct, but always present. They can usually be seen as translucent spots, more or less elliptical in shape, when a fresh leaf is held up to the light. Though these cross-connections are much more distinct in some bamboos than in others, they are not easy to describe precisely as seen with a hand lens on the surface of a leaf, and so they are not used in the present account. They can be seen clearly in microscopic preparations, and details will be given by Dr. C. R. Metcalfe in his publication on the anatomy of the family Gramineae. Gamble described the number of main veins as a possibly useful character in distinguishing leaves of some bamboos, but I have not found it easy to use. Further study of this character is needed.

Just as the blade of a culm-sheath is jointed to the sheath, a foliage leaf-blade is also so jointed; the joint occurs at the base of the leaf-stalk and is shown as a scar of distinctive shape when an old leaf-blade has fallen. As in a culm-sheath also, there are auricles which spread along the top of the sheath on each side of the base of the leaf-stalk. Owing to the asymmetry of the base of the leaf, the two auricles are often not equally developed. The auricles sometimes bear bristles, and their shape and bristliness are sometimes distinctive, but in some bamboos these characters are so variable (on the same plant) as to be unreliable for diagnostic purposes. The sides of the top of the leaf-sheath, where the auricles end, are connected across the front of the base of the leaf-stalk by the ligule. This is usually quite small in bamboo leaves, but is large and distinctive in a few species. Where the ligule is tall, the base-line of the auricles is upcurved to meet it (as in *Gigantochloa ligulata,* fig. 33).

A feature not seen in culm-sheaths is shown by the tops of the sheaths of bamboo foliage leaves. The top of the sheath, where it meets the leaf-stalk, is produced upwards into a rim, which is here called a callus. The callus is low in the middle, and each half is more or less raised and rounded, so that the callus may look like a pair of auricles. The edge of the callus may be hairy or even bristly, but I have not found these to be useful characters. The only species in which the callus is sufficiently distinctive to be diagnostic is *Gigantochloa ligulata,* in which one half of the callus may be considerably elongated and quite thin, more like a ligule in texture.

In the transition from culm-sheath blade to foliage leaf-blade, the base of the blade becomes narrower until it becomes a stalk; at the same time its direct connection with the auricles is broken, and the raised callus at the top of the sheath, below the leaf-stalk, is developed. The auricles always lie between the callus and the sides of the sheath; they are in close contact with the callus but quite distinct from it (fig. 3).

## The Inflorescence of Bamboos and Grasses

Throughout the grass family, the individual flowers are very small (they are often called florets) and are arranged in spikelets, each spikelet protected when young by small empty outer (later basal) bracts called glumes. It is generally considered that the primitive grass spikelet contained several flowers (fig. 6A), but in some existing grasses, and also in some bamboos, each spikelet contains only one perfect flower, sometimes also one or more imperfect flowers. The unit of a grass inflorescence is thus a spikelet, not a single flower. The arrangement of the spikelets on the branches which bear them varies in different kinds of grasses; all arrangements can ultimately be explained as reductions from the condition in which the spikelets are borne in a panicle (fig. 7A); that is, the main axis of the inflorescence has branches, and these branches again bear secondary (or even tertiary) branches which end in spikelets (the main axis itself and the main branches also each end in a single spikelet). A remarkable feature is that in most grasses there are no bracts where the branches of the panicle spring from the main axis; such bracts do however occur in a few grasses, and they are very small. The bamboo genus Arundinaria, which does not occur in Malaya, has inflorescences in the form of panicles in which the branches are in the axils of small bracts, so that in inflorescence-form there is no sharp distinction between Arundinaria and some of the true grasses.

In all the bamboo genera which occur in Malaya, except the peculiar and apparently rare Racemobambos, the arrangement of the spikelets is different. The only person who has described this arrangement is McClure (*Journ. Wash. Acad. Sci.* 24: 541–548. 1934). But nobody appears to have considered how this arrangement is related to that of Arundinaria. Bamboos are generally

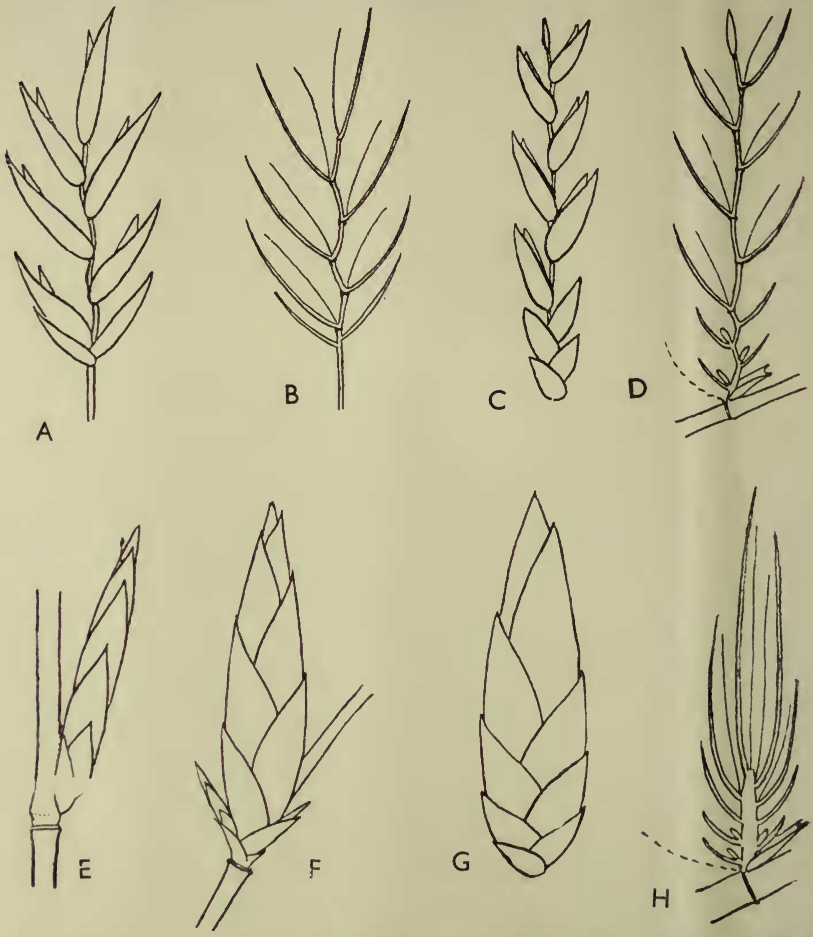

Fig. 6. A, diagram of grass spikelet, with 2 empty glumes and six lemmas each containing a flower. B, longitudinal section of A, floral parts omitted. C, primary flowering branchlet of Bambusa, having 3 bud-bearing bracts, one empty glume, six lemmas containing flowers, and a rudimentary terminal flower. D, section of C, floral parts omitted. E, *Bambusa heterostachya*, primary flowering branchlet showing prophyll backing axis at base, × 4/3. F, face view of E, a later stage showing two secondary branchlets. G, primary flowering branchlet of Dendrocalamus. H, section of G (compare with D; in both cases axis of branch has been turned through a right angle).

regarded as the most primitive members of the grass family, and Arundinaria, connecting bamboos to the main mass of true grasses, as the least primitive among the bamboos. One should logically therefore regard the other tropical bamboos (Bambusa itself, Schizostachyum, etc.) as the most primitive genera; and one ought therefore to see how the Arundinaria type of inflorescence can have arisen from the Bambusa type (or how both originated from some more primitive type). I propose to attempt to do this in the following discussion, and will begin with the inflorescence in Bambusa, afterwards discussing possible transitions between this and the inflorescence in Arundinaria; finally we shall come to a discussion of the individual flower and its parts.

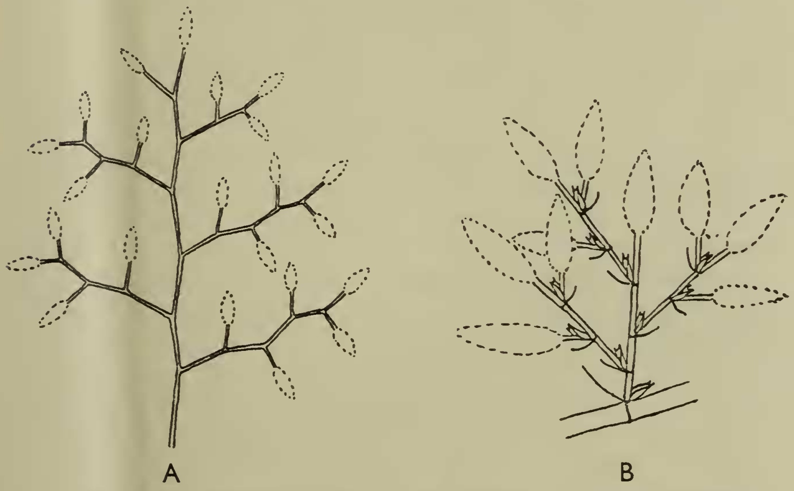

Fig. 7. A, diagram of small panicle of spikelets of a grass (outlines of spikelets dotted); note absence of bracts at branchings. B, Diagram of spikelet-tuft of Bambusa, with all internodes elongated and all spikelets in the same plane.

A young branch of Bambusa which is to bear flowers has a bud in the axil of each sheath (the blades on the sheaths are absent or much reduced); the sheath usually falls as the bud develops. The bud grows out into a short primary branchlet with very short internodes, a small bract at every node, and a two-keeled prophyll backing the parent branch at the base (fig. 6C, 6E). The lowest bract is quite small, then a few others are of gradually increasing size, and the rest are all alike. The lowest bracts have buds in their axils, as have the lowest leaf-sheaths on a vegetative branch, and these buds soon grow out to form short branches like the first one (fig. 6D, 6F); these secondary short branches behave in the same way and each may produce a few tertiary short branches. Thus develops a tuft of short bract-covered branches, the pattern of the whole being exactly like that of the branching at a node on the main culm.

Each of these short branches has flowers in the axils of the upper bracts, which are called lemmas. Each flower is enfolded by a second bract called a palea. Between the lemmas and the basal bud-bearing bracts are usually one or two empty bracts (on secondary and tertiary branches there may be no bud-bearing bracts). These empty bracts correspond to the glumes of ordinary grasses; but it will be noted that in bamboos there is nothing to distinguish a glume from a bud-bearing bract or from a flower-bearing bract (lemma) except the fact that it is empty. The end of the short flowering branch clearly corresponds to a grass spikelet; but where does the spikelet begin?

One supposes that the primitive bamboo had several flowers at the end of each of the short flowering branches (this is the condition of Bambusa) and it is not surprising to find that the uppermost of such flowers is often imperfect. There are other bamboos in which there are very few flowers, or even only one, on each short branch; one must suppose that these have evolved from those with several flowers by a process of reduction.

In Bambusa, the flower-bearing axis of the short branch (i.e., of the spikelet) is jointed below every node. This axis is called the rachilla. There may also be a joint below one or more of the empty bracts below the flower-bearing part. In grasses, the position of such joints is very precise, and is uniform in each genus or group of genera. In Bambusa and other Malayan bamboo genera there is much less regularity, and the question needs further study.

Another kind of reduction can also occur in bamboo spikelets, as compared with the condition of Bambusa. In this case the rachilla is very short and is not jointed below the nodes, which are sometimes only about 0·5 mm. apart. In such a spikelet there may be several flowers. If the lemmas were all alike, their tips would all be very close together; but along with the shortening of the rachilla an arrangement has evolved whereby the outer (lower) lemmas are shorter than the upper ones, and the floral parts also (fig. 6G, 6H). Thus a spikelet of Dendrocalamus does not look very different from some spikelets of Bambusa until one comes to dissect it.

Now how can we rationalize a comparison between the group of short flowering branches at one node found in a bamboo with a panicle of spikelets as found in a grass? If all the lower internodes of a tuft of short flowering branches in the bamboo were much elongated, as far as the empty glumes in each case, we should have something very like a panicle of spikelets, each spikelet on a stalk and either terminal on a branch or in the axil of a bract with a prophyll immediately above the bract (fig. 7B). If we eliminate these branch-bearing bracts and the prophylls adjacent to them, and reduce the empty glumes at the base of each spikelet to two, we have exactly the condition of a grass panicle (there are differences in the floral parts of bamboos and grasses also, and these will be considered later).

I suggest that in the original bamboo (which was also the original grass) groups of flower-bearing branches occurred at the ends of leafy branches (as in some species of Schizostachyum), instead of at the nodes of a leafless branch. This would lead straight to a grass panicle at the end of a leafy branch, by way of the condition found in Arundinaria. By reducing the number of branches and putting each spikelet on a short stalk, we could also reach the condition of Racemobambos; and by eliminating everything except the terminal spikelet we reach the condition of *Schizostachyum terminale.*

Part of the evolution of bamboos has consisted in the evolution of the large hollow woody culm, with its many branches and relatively small leaves. I suggest that along with this vegetative evolution has gone the development of small groups of reduced flowering branches at each node. But the basic floral structure must have been evolved at a very early stage, and represents almost certainly a reduction of floral parts. The most primitive (tropical) bamboos probably retain most nearly the floral pattern of the original plants from which the whole grass family evolved. We will next consider the details of this structure.

## Spikelet and Flower structure, apart from the ovary

As explained above, the primary flower-bearing branch of a bamboo has at its base small bracts with buds in their axils, then empty glumes, and then lemmas having flowers in their axils. The part from the glumes onwards corresponds to a true spikelet; the whole has been termed a *pseudo-spikelet* by McClure. The buds in the axils of the lower bracts on a pseudo-spikelet may grow out into pseudo-spikelets much like the first one, or some of them only into true spikelets. We are here concerned with true spikelets, and with floral parts found in the axils of their lemmas.

In many bamboos, it is not at all easy to observe just how many empty glumes are present; and as may be understood from the above remarks the number of such glumes on branches of different orders may not be constant. In some bamboos there may be a joint below the true glumes, in others only above them. Statements about the glumes of bamboos are thus often unreliable and the whole subject needs critical study. We will ignore them in the further discussion in this section, and deal only with the rachilla, the lemmas, and the floral parts.

The rachilla, where the internodes are not very short, is usually more or less zig-zag, and the shape and hairiness of its internodes may be important. In Bambusa the last flower, which terminates the spikelet, is reduced, both as regards the lemma itself and its floral parts, but the rachilla-internode which bears it is not markedly different from the other internodes, except that it may be shorter (fig. 8A). In Schizostachyum the rachilla-internode which bears the reduced terminal flower is much more slender than the rest; and in some cases the reduced flower is so rudimentary as to be hardly recognizable, or even the whole rachilla-internode above the uppermost perfect flower may be completely aborted. In some species of Dendrocalamus the uppermost flower is perfect, and ends the spikelet. In Gigantochloa the terminal flower is always represented by a long narrow lemma and nothing else. There is no doubt that the way in which the spikelet terminates is often an important character in the discrimination of relationship among bamboos.

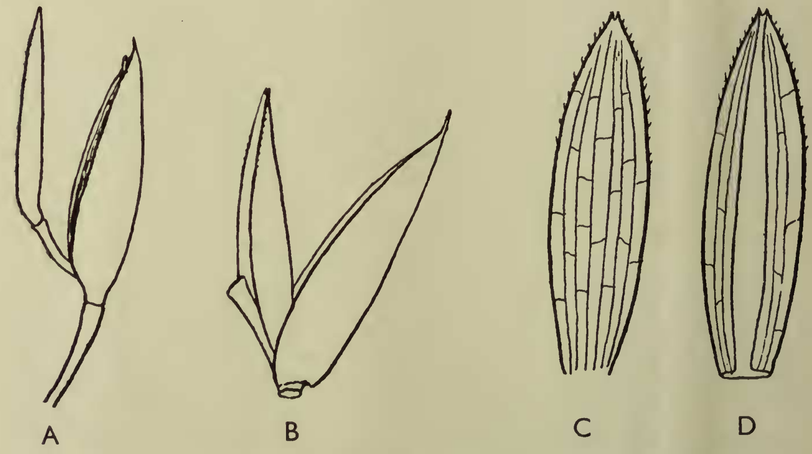

Fig. 8. *Bambusa ridleyi.* A, top of spikelet, showing terminal imperfect flower, and uppermost perfect flower (enclosed by lemma) and rachilla, × 3/2. B, a lower internode of the rachilla, with one lemma (pulled back a little) and its palea. C, back of a palea, showing veins and thickened fringed keels, × 2½. D, front of same palea, showing infolded edges.

Each bamboo lemma is a short sheathing bract, comparable to the sheath of a leaf, usually without any indication of a blade, though it may terminate in a short stiff (almost thorn-like) point which presumably represents a reduced blade. There are always many veins in a lemma (this is a difference from grasses) and usually some cross-veins; the midrib is distinct. There may be hairs on the edge or back of a lemma, and these are often of diagnostic importance.

When one removes a lemma one finds within it a two-keeled prophyll which backs on to the axis of the spikelet and the next higher lemma on the same side (fig. 8B). This prophyll is called a palea. It is of exactly the same nature as the prophyll at the base of every branch in a bamboo plant, but more delicate in structure than most such prophylls. In cases where paleas are exposed when a spikelet is mature (as in those species of Bambusa and Schizostachyum with long rachilla-internodes) the palea is of a much tougher nature than in cases (e.g. Gigantochloa) where it is totally protected by the lemma. The two keels of a palea (as of other prophylls) are usually fringed with hairs; the back and the edges may be hairy also. The parts of the palea between the keels and edges are infolded and embrace the true floral parts. There are always some veins between the keels of the palea (absent in the paleas of grasses), and more between each keel and edge (fig. 8C, 8D).

In the case where a perfect flower terminates the spikelet (as in some species of Dendrocalamus) the palea of that flower lacks the keels, or almost lacks them. In the case of Schizostachyum (fig. 11A) where there is a very slender last internode of the rachilla, bearing a much reduced final flower, the palea of the uppermost (usually sole) perfect flower is very slightly two-keeled, but retains a doubly pointed apex. The absence of the two keels in such cases is probably to be explained simply by the fact that there is no axis nor any further flower behind the palea to exert pressure during development; a normal palea is the shape of the space allowed for it by the development of the other parts of the spikelet, its back being hollow to fit those parts, its edges sharply infolded also to fit them.

The perianth (sepals and petals) of an ordinary flower are represented in most bamboos by three small members called lodicules. They are usually largest in the genus Schizostachyum, but also comparatively large in *Bambusa ridleyi.* As may be seen in some of the transverse sections drawn by Dr. Agnes Arber (*The Gramineae,* fig. 31 p. 90; fig. 38 B1 and D2, p. 115) the lodicules in a Schizostachyum flower are symmetrically placed in the position one would expect three petals to occupy (fig. 9C). The lodicules are always delicate structures without any fibrous cells. The basal part of lodicules is rather thick and the swelling cells in this region in some cases at least cause a separation of lemma and palea sufficient for the emergence of the developing stamens and stigmas. In Bambusa the lower part of two of the lodicules is sometimes very much swollen (fig. 9A), in Schizostachyum slightly (fig. 9B). The distal part of lodicules is usually thin and translucent, often fringed with hairs. The lodicules of grasses often consist of the fleshy basal part only. In most bamboos there is some inequality in the lodicules, two being alike (and sometimes asymmetric, one more or less the mirror image of the other) and the third smaller, symmetrical. In some species of Schizostachyum there are transitions between stamens and lodicules, in the same kind of way that there are transitions between petals and stamens in many other more normal flowers; this is part of the evidence for the petal-nature of lodicules. In the genus Ochlandra (Southern India and Ceylon), closely related to Schizostachyum, there are often more than three lodicules; this is connected with the fact that there are also more than six stamens. In most species of Gigantochloa and Dendrocalamus there are no lodicules, and they are also sometimes lacking in species of other genera.

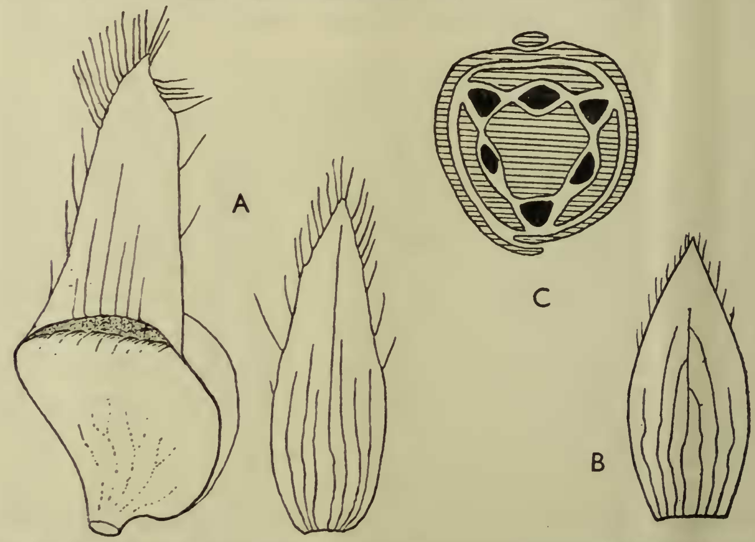

Fig. 9. A, *Bambusa ridleyi,* one of the two larger lodicules, and the single smaller one, × 5. B, *Schizostachyum brachycladum,* one lodicule, × 6. C, transverse section of floret of *Cephalostachyum virgatum,* showing palea enfolding 3 equal and symmetrically placed lodicules, 6 stamen-filaments, and top of ovary (after Arber).

The usual number of stamens in bamboo flowers is six. In Arundinaria and most grasses there are three stamens, this being considered as a reduction from six and a further indication of the more highly specialized nature of Arundinaria. In some species of Schizostachyum there are transitions from stamens to lodicules, and then there may be only 4 or 5 stamens, the other one or two being wholly or partly transformed into lodicules.

The anthers are always long, and their length when mature may be a useful diagnostic character, but in the cases of Gigantochloa and Dendrocalamus, where the lower paleas are much shorter than the upper ones on the same spikelet, one needs to observe the length of the anthers in the uppermost perfect flowers. The connective of the anther is often prolonged at the apex to form a sterile tip projecting beyond the ends of the pollen-sacs; this sterile apex may bear hairs or papillae (fig. 10I). In some species the extent of development of the anther-tips is variable (fig. 10F, G, H).

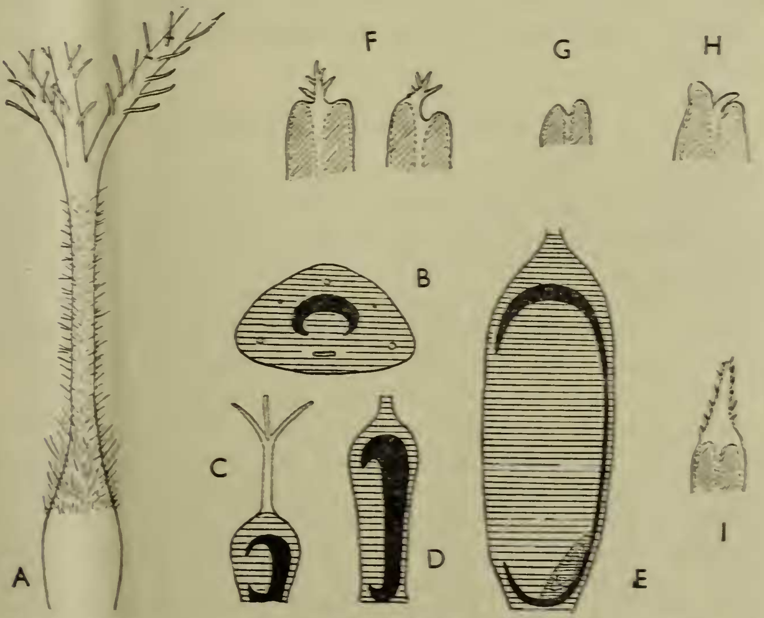

Fig. 10. A, *Bambusa ridleyi*, ovary with style and part of stigmas. × 10. B, *Gigantochloa scortechinii*, transverse section of ovary, showing position of ovule and vascular strands (after Arber). C, diagrammatic longitudinal section of ovary of Bambusa. D, same, after fertilization. E, diagrammatic longitudinal section of fruit of Bambusa. F, *Bambusa heterostachya*, tips of 2 anthers. G, *Bambusa klossii*, tip of anther. H, *B. ridleyi*, same. I, *Gigantochloa wrayi*, same.

The filaments of bamboo stamens, as of grass stamens, are at first very much shorter than the anthers, and elongate rapidly when the flower opens to become delicate threads longer than the anthers. In some bamboos the filaments are not separate, but collectively form a tube which when extended surrounds the ovary and style, or sometimes two or three filaments are joined. This fusion of filaments (or rather, the development of a tube in place of the separate filaments) occurs in several bamboo genera which in my opinion are not closely related. Mlle A. Camus has proposed a classification of bamboos in which such genera are placed in a distinct sub-tribe (*Arch. Mus. Hist. Nat. Paris* VI, 12: 601. 1935). This seems to me a quite unnatural arrangement; it involves taking some species of what I would call Schizostachyum and putting them into a different sub-tribe from the other members of the genus, and alongside Gigantochloa which has an ovary and a spikelet of quite different structure. In some species (especially of Dendrocalamus) it is very difficult to decide whether the expanded filaments form a tube or not, because they are so delicate; in other cases (e.g., Gigantochloa) the tube is much firmer and quite easy to observe.

## The Ovary and Fruit in Bamboos

The ovary in bamboos, as in grasses, is unilocular, but it contains clear evidence of its derivation from the typical tricarpellary ovary shown in many families of Monocotyledons. Dr. Arber (*The Gramineae,* p. 122, fig. 45 B1) shows the existence of vascular bundles corresponding to three carpel midribs, and also the fused marginal veins of the carpels. The single ovule is joined to one of these marginal veins, the vascular tissue in this case being much enlarged to supply the needs of the developing seed (fig. 10B).

As regards the external form of the ovary, there are two principal types among Malayan bamboos. In the Bambusa type of ovary the top of the ovary-wall is thickened and often forms a (usually hairy) swelling wider than the hollow basal part of the ovary; the three stigmas are either borne directly by this swollen top of the ovary, or there may be a style of varying length (fig. 10A). In most species of Gigantochloa and Dendrocalamus the style is continued into a single stigma.

In Schizostachyum (also in Ochlandra and Melocanna outside Malaya) a very different type of ovary occurs, and its detailed structure needs examination from microscopic preparations. The ovary is continued upwards into a gradually tapering, rigid structure which is a little longer than the palea and bears three short spreading stigmas at its apex (fig. 11C). The cavity of the ovary is apparently quite small and basal, as in Bambusa. The upward extension appears to be comparable to the swollen fleshy top of the Bambusa ovary; it is in effect a style, and I have so called it as others have done, but there is no external mark of separation between ovary and style. At the time of flowering, this rigid style appears to contain a free central strand of tissue which connects the stigmas with the ovary proper, and I have seen nothing like this in other bamboos (fig. 11D). Dinochloa has such very short spikelets that the ovary with its style are also necessarily very short, and a comparison between this ovary with that of other bamboos is not easy to make. I believe that the ovary in Dinochloa is similar to that of Bambusa, not to Schizostachyum, next to which Dinochloa has usually been placed.

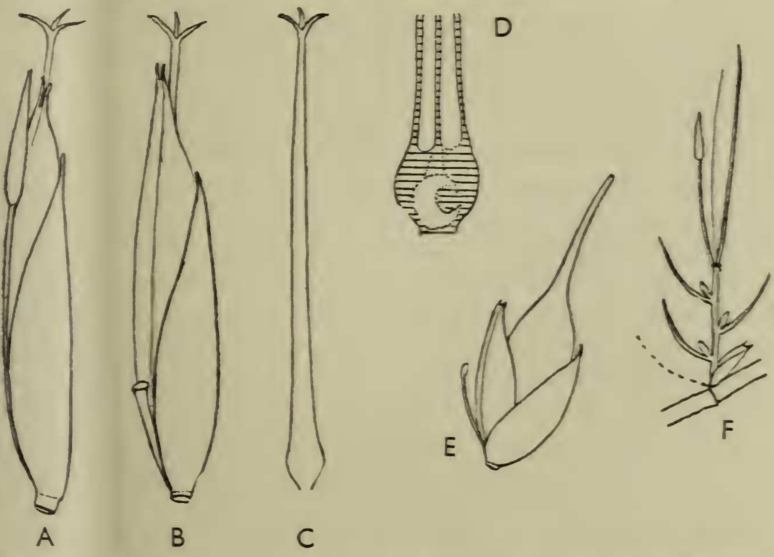

Fig. 11. A–D, F, *Schizostachyum brachycladum*. A, upper perfect floret and rudimentary floret on slender extension of rachilla; back of palea slightly grooved near tip, × 4. B, lower perfect floret with rachilla-internode; palea grooved from top to bottom. C, ovary and stigmas. D, diagrammatic longitudinal section of base of ovary. F, diagrammatic longitudinal section of a pseudo-spikelet, for comparison with fig. 6 D & H (only one perfect floret). E, ripe fruit of *S. gracile*, enclosed by lemma and palea, × 2.

As an ovary develops into a fruit, it is naturally the portion containing the ovule which enlarges most. The various structures formed by the top of the ovary, which serve to bear the stigmas, are usually only slightly enlarged (fig. 10C, D, E). As the cavity of the developing fruit enlarges, the attachment of the developing seed to the ovary wall (i.e., the hilum) elongates, so that the hilum of a ripe seed extends almost throughout its length. The embryo of a ripe seed is usually small and round, at the base of the seed on the side opposite to the hilum; the rest of the seed consists of endosperm. The whole seed is elongate and more or less cylindrical to narrowly fusiform in shape. The exceptions to this rule do not occur in Malaya; they are the bamboos with large fruits of the genera Melocanna, Ochlandra, Melocalamus, and Dinochloa. In these fruits the pericarp becomes thick and fleshy throughout. In the only species examined in detail, *Melocanna bambusoides,* the scutellum of the embryo grows at the expense of the endosperm until it fills almost the whole seed. A cursory examination of a fruit of Melocalamus indicates a similar structure; the fruit of Ochlandra has never been investigated. In Melocanna and Melocalamus the seed germinates while the fruit is still attached to the parent plant; the growth of the scutellum is a consequence of this fact.

The upper part of the pericarp in all Malayan bamboos is distinctly thickened and is free from the top of the seed. The pericarp (ovary wall) becomes thinner towards the base, so that the sides of the seed in the ripe fruit have quite a thin covering, through which the position of the embryo can usually be seen when the fruit is dry and slightly shrunken. In my experience, it is usually possible to separate the thin lower parts of the pericarp from the seed, as a sort of skin, in a freshly gathered fruit which has reached its full size but has not hardened. Munro's proposed division of bamboos into those with a fleshy pericarp and those with a thin adherent pericarp, with Dendrocalamus in the former division and Bambusa in the latter, is thus quite unjustifiable, though it has been repeatedly copied for nearly a century. I can see no essential difference in structure between the fruits of Dendrocalamus and Bambusa.

Munro saw few fruits, the only one in Dendrocalamus being of *D. strictus.* Had he seen the fruits of other species which are clearly allied to *D. strictus* (e.g., *D. pendulus* Ridl.), he would have realized, as Gamble must have done, that the lower part of the pericarp in most Dendrocalamus species is quite thin, so that the position of the embryo shows externally, a fact indicated in several of Gamble's figures. But Gamble seems to have been determined not to alter the scheme of classification of Bentham in *Genera Plantarum,* a scheme copied almost completely from Munro, though Gamble certainly realized that his further knowledge, of more than one kind, invalidated that scheme (the generic descriptions of Gamble do not is all cases agree with the statements about those genera in the keys to sub-tribes and to genera, which he took from Bentham). I wrote a note calling attention to this unsatisfactory state of affairs, and suggesting a tentative new scheme of classification, in 1946 (*Journ. Arn. Arb.* 27: 340–346). Since writing that note, I have come to the conclusion that Bambusa, Gigantochloa and Dendrocalamus are more nearly related than I realized in 1946; that the position of Dinochloa is probably wrong; that Oxytenanthera is a distinct genus, wholly African, differing in the top of its ovary from Dendrocalamus; and that the suggested distinction of "Oxytenanthera" (i.e., of Asiatic species referred by Gamble and Ridley to that genus) from Dendrocalamus is probably not valid.

As above noted, the genus Dinochloa is peculiar, and I have always felt doubtful of its position along with Schizostachyum. Fruits of *D. scandens* in Java, and of *D. andamanica* Kurz have the pericarp quite thin towards the base, thickened a little and beaked at the top, quite as in some species of Bambusa; the embryo is larger than usual in proportion to the size of the seed, but I see no fundamental difference. A species of Dinochloa from Borneo and the Philippines has however spherical fruits with fleshy pericarp. The aspect of the spikelets in some Dinochloas is very like those of the slender subscandent Bambusa species of Malayan mountains. I am inclined to put Dinochloa near Bambusa, not near Schizostachyum, but a further study of fruits is needed for a better understanding of the genus.

### Scheme of Classification of Malayan Bamboos

Top of ovary narrowed gradually upwards to form a rigid hollow style longer than the palea at flowering, the stigmas diverging from its top .. .. 1. *Schizostachyum*

Top of ovary more or less fleshy, not rigid nor hollow, variously shaped, bearing the three stigmas directly, or more or less abruptly attenuate to a slender style which bears 1–3 stigmas

  Spikelets forming the distal parts of short branches which are borne in close tufts at the nodes of a stem

    Rachilla-internodes distinctly elongate, with a joint below the lemma-attachment at each node

      Paleas all alike, not deeply bilobed 2. *Bambusa*

Lowest palea deeply bifid .. 3. *Thyrsostachys*

Rachilla-internodes not elongate, not jointed below each lemma if several flowers present, or flower single without an extension of the rachilla beyond it

Spikelets less than 5 mm. long, with one flower; ovary-top gradually attenuate and bearing three stigmas .. .. 4. *Dinochloa*

Spikelets more than 5 mm. long, usually with more than one flower; ovary-top gradually attenuate to a hairy style which usually bears one stigma

Uppermost or sole perfect flower with unkeeled (or incompletely 2-keeled) palea, paleae of all other perfect flowers 2-keeled; a terminal short imperfect flower present or not .. .. 5. *Dendrocalamus*

All perfect flowers with 2-keeled paleae; a terminal imperfect flower consisting of a long narrow lemma (as long as uppermost normal lemma) always present .. .. 6. *Gigantochloa*

Spikelets borne singly in a short raceme at the end of a leafy branch .. 7. *Racemobambos*

**General key to Peninsula bamboos based on vegetative characters**

Culms bearing many spreading thorny branches at lower nodes *Bambusa*

Culms usually without branches at lower nodes; such branches, if present, not thorny

Exposed parts of internodes of young culms bearing throughout many appressed pale hairs, lacking white waxy powder

Auricles forming a low firm rim (dark green when young) along the top of the sheath on each side of the blade; bristles on auricle-edge scattered .. *Gigantochloa apus*

Auricles of different shape, bristles always close and numerous along their edges . . . . . . . . . . . . . . *Schizostachyum*

Exposed parts of internodes of young culms quite smooth, or covered with white waxy powder; or if hairy, the hairs near top of internodes only, not spread evenly throughout

Fully developed culms not strong enough to bear the weight of their branches, more or less climbing in habit, curved over from base if not supported by surrounding trees

Longest internodes 200 cm. long . . . . . . *Bambusa wrayi*

Longest internodes much shorter

Young culm-sheaths bearing much white waxy powder among the felted pale hairs; young culm itself usually covered with white waxy powder *Dendrocalamus*

Young culm-sheaths and young culms lacking waxy powder

Bases of fallen culm-sheaths persisting as leathery rims of uneven width; young unbranched culms weak, sometimes trailing on ground. . . . . . . .*Dinochloa*

Culm-sheaths falling to leave an even scar; unbranched young culms usually rigid and erect

Leaf-auricles 4–10 mm. tall, taller than wide, bearing bristles to 20 mm. long. . . .*Bambusa ridleyi*

Leaf-auricles otherwise, usually much smaller

Culms only about 1 cm. diameter (?); on mountains in Johore (culm-sheaths unknown) *Racemobambos*

Culms stouter; on mountains of Main Range and north of Malaya . . . . . . . . . . . . . . *Bambusa*

Fully developed branch-bearing culms rigidly erect near the base at least, usually almost erect for greater part of their height

Lowest internodes of old culms persistently covered with close felt of fine brown hairs; commonly cultivated *Dendrocalamus asper*

Lowest internodes of old culms not so covered

Leaf-auricles 4–10 mm. tall, taller than wide, bearing bristles to 20 mm. long . . . . . . . . *Bambusa ridleyi*

Leaf-auricles otherwise, usually much smaller

Slender bamboos on limestone rocks in the north *Dendrocalamus*

- Bamboos in other parts of Malaya
  - Culm-sheath blades on middle sheaths quite erect, or spreading only slightly
    - Culm-sheath ligule 10–25 mm. tall including its fringe of bristles; auricle a low firm rim, bristly or not . . . . . . . . . . . . . *Gigantochloa*
    - Culm-sheath ligule shorter; in most cases auricle otherwise
      - Culm-sheath ligule not over 5 mm. tall, its edge entire or bearing fine short hairs
        - Culm-sheath auricles forming a low firm rim along top of sheath each side of blade *G. ridleyi*
        - Culm-sheath auricles otherwise
          - Culm-sheath auricles not over 4 mm. tall and wide, often much smaller, usually bristly
            - Successive culm-internodes forming a zigzag pattern . . *Bambusa ventricosa*
            - Successive culm-internodes in an almost straight line
              - Hedge bamboo; culms to 2 cm. diameter; leaf-blade velvet hairy and glaucous beneath *Bambusa glaucescens*
              - Larger bamboos; leaves not glaucous beneath
                - Old culm-sheaths very persistent, thin and papery; leaves commonly to 12 cm. long and 8 mm. wide, glabrous beneath *Thyrsostachys siamensis*
                - Old culm-sheaths not thin and papery; leaves commonly larger, more or less hairy beneath *Dendrocalamus strictus*
          - Culm-sheath auricles much larger *Bambusa*
      - Culm-sheath ligule (on well-grown plants) over 5 mm. tall, its edge bearing tapering bristles . . . . . . . . . . . *Bambusa heterostachya*

Culm-sheath blades on middle sheaths spreading or reflexed
  Slender bamboo of high mountain ridges on Main Range; culm-sheath blade quite reflexed, commonly 10 cm. long and 3 mm. wide *Bambusa magica*
  Lowland bamboos, native or introduced
    Very large bamboo, culms 18–25 cm. diameter near base . . . . *Dendrocalamus giganteus*
    Smaller bamboos
      Culm or sheaths (or both) when young bearing white waxy powder
        Culm-sheath blades of middle sheaths green and leaf-like *Gigantochloa scortechinii*
        Culm-sheath blades of middle sheaths rigid, pinkish, not leaf-like *Dendrocalamus*
      Culm and sheaths when young lacking a white waxy powder . . . . *Gigantochloa*

## SCHIZOSTACHYUM

**Schizostachyum** Nees, Agrost. Bras. 534. 1829.

Type species: *S. blumii* Nees, l.c., from Java. McClure in Blumea 2: 86–94. 1936.

*Culms* short to tall, the top usually very slender and drooping; walls (except in the non-Malayan *S. caudatum*) relatively thin; surface of young culms bearing closely appressed white hairs; branches usually rather short and densely tufted at the nodes. *Culm-sheaths* with broad or narrow erect or reflexed blade; auricles small or large, always with slender curved bristles; ligule often with a short fringe of hairs or slender bristles, never with long bristles. *Spikelets* in groups at the distal nodes of a branch the base of which is leafy, or on wholly leafless branches, in *S. terminale* solitary and terminal on leafy branches; each spikelet with a few bud-bearing bracts below it, and no true glumes between these and the first (or only) floret, at the base of which the rachilla is jointed (fig. 11F). *Perfect florets* one or more, the rachilla jointed at the base of each and produced as a slender extension beyond the uppermost to bear a sterile (often rudimentary) floret at its tip (this extension usually lacking in *S.*

*jaculans,* and in some allied species not in Malaya). *Lemma* of sole floret, or of uppermost perfect floret, tightly rolled round the palea, with a short spine-like tip; of lower florets (where present) rather loosely enclosing the palea. *Palea* similar to the lemma in texture, usually longer than its lemma, its apex with 2 points close together, the points at the ends of more or less developed keels with a narrow groove between them which may extend to the base of the palea, the rachilla (or its extension) in the groove (fig. 11A, B). *Stamens* usually 6 (4 in *S. insulare*), filaments usually free; in some species transitions between stamens and lodicules may occur. *Lodicules* usually present, the number sometimes not constant in different spikelets on the same plant, sometimes quite lacking. *Ovary* smooth, continued upwards into a gradually tapering stiff style which is hollow around a central strand of tissue, terminating in 3 short spreading stigmas, the style at flowering usually a little longer than the palea (fig. 11C, D). *Fruit* smooth, about as long as the lemma, bearing the persistent stiff style at its apex (fig. 11E); *seed* more or less cylindric, separable from the thin stiff pericarp (which is thicker towards top of fruit); *hilum* linear, extending the whole length of the seed; *embryo* small.

**Field characters.** Some of the Peninsula species flower continuously on leafy branches. In these cases the slender shape of the spikelet, with its stiff style protruding from the tightly folded lemma and palea, is distinctive. Of vegetative characters, the presence of fine appressed white (or colourless) hairs on the young culms is universal, and only otherwise found in *Gigantochloa apus* (not native and not commonly planted). Several species have erect culms with slender drooping tips. *S. gracile* and *S. grande* have culms not strong enough to support their own weight, and if not supported by other plants curve even from the base and may form a semicircle (this occurs also in *Dendrocalamus pendulus*). The range of shape of blade and of auricles on culm-sheaths shown by different species in this genus is considerable, but the auricles are always bristly.

**Limits of the genus.** The above generic description would include both Cephalostachyum and Teinostachyum of Gamble's scheme. Gamble originally placed these two genera in a different sub-tribe from Schizostachyum, the only clear difference in the diagnoses of the sub-tribes relating to the palea; in Dendrocalameae the palea is said to be 2-keeled, in Melocanneae "none, or similar to the flowering glume" (Gamble copied this from Bentham).

In Gamble's generic description of Cephalostachyum, the palea is described as "2-keeled, keels close together". But in the description of the species *Schizostachyum tenue* (belonging to Melocanneae) the palea is described in exactly the same words used for Cephalostachyum, and I would agree with that description (fig. 11E). All one-flowered species of Schizostachyum examined by me have a palea with two apical points close together. These apices are usually elongated and 0·5–2·0 mm. long, and they are more or less clearly produced downwards on the back of the palea as two keels, with a more or less distinct groove between them. I do not think it is possible to divide these species clearly into those with 2-keeled and those with un-keeled paleas, or to separate them on these characters from species referred by Gamble to Cephalostachyum. Some species of Cephalostachym (especially the original *C. capitatum* and *C. pallidum*) are very distinct in aspect when flowering, owing to the numerous very long-awned bracts surrounding the dense groups of spikelets. But this is not true of *C. virgatum* Kurz, and it is not clear to me why Gamble did not refer it to Schizostachyum.

Teinostachyum, as originally defined by Munro, has several perfect flowers in each spikelet (Bentham would only admit one flower, and Gamble, copying Bentham's scheme of generic separation in his subtribal keys, had therefore a conflict between the key on p. 77 and the diagnosis of Teinostachyum on p. 97). It might seem reasonable to separate Teinostachyum from Schizostachyum on the number of florets in a spikelet (one in Schizostachyum, more than one in Teinostachyum). But I have found that the spikelets of *S. brachycladum* (on specimens from several parts of Malaya) have sometimes one flower, sometimes two; and sometimes there is an empty lemma to represent the first flower. Where there are two perfect flowers, the upper one has a tightly convolute lemma and palea, with only slight keels near the tip of the palea; in the lower flower the palea is not completely enfolded by the lemma, and has a distinct groove from tip to base (fig. 11B). This is the condition of Teinostachyum also; the rachilla lies in the groove of the palea of the lower flower (or of all flowers below the last perfect one), but in the case of the uppermost perfect flower there is no rachilla (only its thread-like extension) and the palea is usually only slightly grooved (fig. 11A). *Schizostachyum grande* Ridl. has about four perfect flowers, all except the apical one having fully grooved paleas, with stout rachilla-internodes lying in the grooves.

*Schizostachyum brachycladum* is so closely related to *S. zollingeri* in every respect except the frequent presence of two flowers in spikelets of the former that it would be very unnatural to place them in different genera. The sharp distinction between Teinostachyum and Schizostachyum on number of florets therefore breaks down, and I see no other possible separation of the combined group of species of the two genera. The genus Dendrochloa Parkinson has a spikelet-structure identical with that of *S. grande* Ridl., and so it also should be included.

There is a group of species of Schizostachyum for which the name Neohouzeaua has been proposed by Mlle A. Camus. I believe that this is a natural group of species, but the only character which they all possess is a filament-tube instead of separate filaments. They mostly lack lodicules, but so also does *S. blumii* (type species of the genus) and some of them lack an extension of the rachilla. I have argued elsewhere (Journ. Arn. Arb. 27: 341. 1946) that the presence of a filament-tube is not of basic importance in the classification of bamboos, as it occurs on at least three different evolutionary lines; and there is also evidence that it may occur at another point in Schizostachyum (it is partial in *Dendrochloa distans* Parkinson, which certainly belongs to the same genus as *S. grande* Ridl.). I do not think that this character alone is sufficient to warrant the separation of a genus; but if it were possible, as it may be when we know them better, to separate these species on a group of other characters, then generic distinction may be justified. The Malayan representative of this group is *S. jaculans*.

DISTRIBUTION: as here construed in a broad sense, this genus has as its centre of distribution the Burma-Siam-Indochina region. There are certainly native species throughout Malaysia (including the Philippines and New Guinea), and apparently a few in the islands of the Pacific. There are a few species in southern India, Ceylon and Madagascar. In Malaya there are several wild species, of which *S. zollingeri* is planted as a village bamboo; *S. brachycladum*, probably not native, is also extensively planted. *S. jaculans*, used for making blow-pipes, has been planted in most parts of the country and is probably wild in the north.

**Uses.** The thin-walled very straight culms of *S. zollingeri* are the lightest bamboos of their size in Malaya, and so they are used for making rafts. Probably *S. brachycladum* is used similarly where it occurs. These bamboos are also used as vessels in which rice is cooked (lĕmang). Because they are easily split and then flattened, they are used for making the walls (and floors ?) of houses. But they split too readily to make useful strips for weaving the side of large baskets; in the preparation of such strips the splitting must be carefully controlled. I found that the culms of *S. grande*, roughly split and twisted, were used for making the rims of large baskets in the Cameron Highlands district. For the side of the baskets thin strips of Gigantochloa were used, made by first vertical and then tangential cuts; tangential cutting of Schizostachyum is impracticable. The siliceous surface of culms of Schizostachyum is very hard, and probably bamboos of this genus are best for making small implements in which sharp edges are required. A probable Schizostachyum was reported by Rumphius as used in Amboina for making spears and also for flutes. *S. jaculans* is used for making blow-pipes in Malaya. Fibres obtained by macerating culms of *S. brachycladum* are used for weaving in some parts of Indonesia, but I have seen no report of this use in Malaya.

### Key to Malayan species of Schizostachyum based on spikelet-structure

- Spikelets with one fertile floret (sometimes 2 in *S. brachycladum*)
  - Spikelets-groups 1–5 on the end of a slender leafy branchlet; few spikelets in each group .. .. 1. *S. gracile*
  - Spikelet-groups more numerous, on a straight rigid axis; many spikelets in a group, sometimes on branched axes
    - Lemma 27 mm. long, its whole outer surface hairy .. .. 2. *S. aciculare*
    - Lemma not over 21 mm. long, its whole outer surface not hairy ..
      - No lodicules; rachilla-extension usually absent .. .. 3. *S. jaculans*
      - Lodicules and rachilla-extension present
        - Lemma 9–12 mm. long
          - Only one perfect floret; lemma 8–9 mm. long; rudimentary floret very small .. 4. *S. zollingeri*
          - Sometimes 2 perfect florets; lemma 12 mm. long; rudimentary floret to 6 mm. long .. .. 5. *S. brachycladum*
        - Lemma 15–21 mm. long
          - Stamens 4; lodicules 2; rachilla-extension 13 mm., rudimentary floret 6 mm. long 6. *S. insulare*

Stamens usually 6; lodicules 3 or more; rachilla-extension to 7 mm., rudimentary floret under 0·5 mm. long . . 7. *S. longispiculatum*

Spikelets with 3 or 4 fertile florets

Spikelets at several nodes on leafless ends of branchlets . . . . 8. *S. grande*

Spikelets solitary, terminal on a leafy branchlet (with one or more others afterwards at its base ?) . . 9. *S. terminale*

**Key based on vegetative characters** (excluding *S. insulare*)

Culm-sheath blades at 150 cm. above ground stiffly erect, as wide as long or nearly so

Culms to about 2 cm. diameter; leaves to 20 by 2 cm. . . . . 1. *S. gracile*

Culms much thicker; leaves much wider

Culm-sheath hairs dark brown; blades much inflated; auricles to 7 mm. or more high . . . . 4. *S. zollingeri*

Culm-sheath hairs red-brown; blades not much inflated; auricles usually not over 2·5 mm. high . . 5. *S. brachycladum*

Culm-sheath blades much longer than wide, erect or spreading

Culm-sheath blades erect, to 17 by 10 cm.; leaves commonly 50 by 7 cm.; leaf-ligule to 8 mm. high . . 8. *S. grande*

Culm-sheath blade deflexed or erect, smaller; leaves smaller; leaf-ligule much shorter

Culm-sheath blade about 8–10 times as long as wide

Longest internode on a culm commonly 80 cm., sometimes much more; bristles on auricles 10–12 mm. long . . . . 3. *S. jaculans*

Longest internode on a culm shorter; auricle-bristles usually shorter

Culm-sheath auricles 3–5 mm. high, with free spreading ends 5 mm. long .. .. 7. *S. longispiculatum*

Culm-sheath auricles not over 2 mm. high, ends not spreading to form free lobes

Top of culm-sheath truncate .. 2. *S. aciculare*

Top of culm-sheath triangular 9. *S. terminale*

Culm-sheath blade about twice as long as wide .. .. .. 1. *S. gracile*

Culm-sheaths not known .. .. 6. *S. insulare*

1. **S. gracile** (Munro) Holttum in Kew Bull. no. 2, 1956: 206.

Basonym: *Melocanna gracilis* Munro in Trans. Linn. Soc. 26: 133. 1868.

Synonym: *S. tenue* Gamble in Ann. R. Bot. Gard. Calc. 7: 114, pl. 100. 1896. Ridley, Flora 5: 268.

*Culms* 3–4 m. long, 1·5–2·0 cm. diameter, not stiffly erect. *Culm-sheaths* when young bearing very fine appressed light brown hairs; *blades* of middle culm-sheaths erect, stiff, commonly 3–4·5 cm. long and 1·5–3 cm. wide, apex stiffly acuminate, upper surface pale-hairy near base; blades of upper sheaths elongate and slightly reflexed; *auricles* about 10 mm. in lateral extent with free outer ends projecting beyond the width of the sheath, 2–3 mm. high, free edge throughout bearing close curved almost smooth bristles (often somewhat purplish) to 10 mm. long; *ligule* under 0·5 mm. high including a fringe of fine hairs. *Leaf-blades* commonly 10–20 cm. long, 1–2 cm. wide (on sucker-shoots to 3 cm.), surfaces smooth and glabrous; auricles small, sometimes with a few slender bristles. *Inflorescence* of 1–6 groups of spikelets at the distal nodes of a very slender more or less flexuous leafy branchlet, few spikelets in each group. *Pseudo-spikelets* 12–14 mm. long at flowering; lemma 8–9 mm. long, glabrous, with stiff tip; *palea* 10–12 mm. long, very shortly 2-pointed with a narrow groove almost to the base; *lodicules* 3, fringed; ripe *fruit* about as long as palea, narrowed at the top and bearing the stiff style, total length 20 mm. (fig. 11E); *seed* 6·5 mm. long, embryo 1 mm.; *rachilla-extension* 6–7 mm. long, rudimentary floret hardly 0·5 mm. long.

DISTRIBUTION: southern half of Malaya, on the edge of forest, often on river-banks in Johore (also in Malacca, Negri Sembilan and Pahang).

RECORDED MALAY NAMES: Buloh Rappen, Buloh Akar.

The above vegetative description is based on plants (introduced from the wild) cultivated at the Federal Experiment Station of the Department of Agriculture, Serdang, Selangor. These plants are in separate clumps in the open; the old culms are not strong enough to stand upright with the weight of their branches.

The type specimen of *Melocanna gracilis* Munro is Wallich no. 5032 collected at Singapore. I have seen three sheets of this collection at Kew, and have no doubt that they represent the same species as *S. tenue* Gamble, as typified by Ridley's no. 5596 (K. Berar, Pahang). Gamble confused the three closely allied species *S. gracile, S. zollingeri* and *S. brachycladum,* and in fact it is not always easy to separate herbarium specimens, though the living plants are distinct. Gamble further confused the situation by using the name *chilianthum,* which properly belongs to a species of another genus (not in Malaya). He put the type of *S. gracile,* and some specimens I would call *S. zollingeri,* into *S. chilianthum.* There are some intermediate specimens, which seem to me to match a living plant I saw near Tampin; these are tentatively referred to a variety *erectum,* described below. Gamble thought that his *S. tenue* might be equivalent to *Bambusa elegantissima* Hassk., but the latter has now been referred to the genus Chloothamnus by Henrard.

*Specimens:* SINGAPORE, Wallich 5032 (K, type). JOHORE, S. Tebrau, Ridley 13211, 11496 (S.K). Kota Tinggi, Ridley 15413 (S,K); s.n. Dec. 1892 (S.). Segamat, Holttum S.F.N. 38302 (S). Danau, S. Sedili, Corner s.n. 28.3.1932 (S). MALACCA, Bukit Toongul, Ridley 5601 (S,K). Ayer Panas, Ridley s.n. 1891 (S.). SELANGOR, Labu River, Ridley 7789 (S.) Federal Expt. Station, cult., Holttum S.F.N. 37791 (S). PAHANG, K. Berar, Ridley 5596 (S,K). Pekan, Burkill & Haniff S.F.N. 17120 (S). TRENGGANU, Kemaman, Vaughan Stevens s.n. 1891 (S); same origin, cult. Singapore, Ridley 6900 (S,K).

**Var. erectum** Holttum, var. nov.

Culmi rigidiores, erecti, apice solum nutantes; vaginae culmorum dorso pilis paucis pallidis vestitae; laminae vaginarum culmorum longiores, auriculae parvae, haud elevatae, latitudine c. 5 mm.; spiculae plures.

TYPE: Negri Sembilan, near Tampin, Holttum S.F.N. 38408 (S.).

The type of this variety had erect slender culms, drooping at the tip only, like a small condition of *S. zollingeri*; but the blades and auricles of the culm-sheaths were very different from *S. zollingeri,* the blades being longer and the auricles small and low. The spikelets were more numerous in each group than is normal in *S. gracile;* this is also a resemblance to *S. zollingeri,* but the axis bearing the spikelets is slender and flexuous, as in *S. gracile,* not rigidly straight. Among herbarium specimens of the Malacca region I have found some others which have the same kind of flowering branches, and place them also tentatively here. In the Waterfall Garden, Penang, is a plant of similar habit, introduced from an unrecorded locality in Malaya. It differs from the above description in having culm-sheaths bearing dark hairs, with fairly large auricles; flowers have not been seen.

Several specimens of *S. gracile* and its variety have ripe fruits; I have not seen any such on *S. zollingeri*.

*Specimens* (of var. *erectum*): MALACCA, Derry 192 (S). Vaughan Stevens 3947 (S,K). NEGRI SEMBILAN, Pantai, Ridley 10069 (S,K). SELANGOR, near Sepang, Ridley 7780 (S,K). cult. SINGAPORE, Ridley 6892 (S,K), 11349 (S,K), s.n. 1903 (S).

2. **S. aciculare** Gamble in Ann. R. Bot. Gard. Calc. 7: 117, pl. 104. 1896. Ridley, Flora 5: 270.

A small bamboo. *Culm-sheaths* 12 cm. long, the top truncate, hairs few, appressed, pale; *blade* reflexed, 8 cm. long, 7 mm. wide; *auricles* 4–5 mm. in lateral extent, 1·5 mm. high, with many close curved bristles to 3 mm. long; *ligule* 1·5 mm. high, including a fringe of short hairs. *Leaf-blades* to about 22 by 5 cm. (sometimes 22 by 3·5 cm.), glabrous or the lower surface a little hairy near the base, petiole 5–8 mm. long; auricles shortly spreading, bearing several bristles; ligule short, with some short slender marginal bristles when young. *Inflorescences* to about 30 cm. long, at the ends of leafy branches, usually unbranched, the spikelet-groups 2·5–5 cm. apart. *Pseudo-spikelets* to 5 cm. long; basal bud-bearing bracts several, rather small, with one longer (2 cm.) sheathing the base of the lemma, its apex not spinous; internode between uppermost bract and lemma to 1 cm. long, its apex with a fringe of short hairs, articulated at the base of the lemma; perfect flower one, with a very slender rachilla-extension nearly as long as the lemma; *lemma* c. 27 mm. long, very shortly pointed, tightly rolled (diameter of rolled lemma 1·5 mm.), outer surface throughout bearing short obliquely spreading hairs; *palea* about 2 mm. longer than lemma and almost entirely enclosed by lemma, apical points short; *lodicule* 1 (seen by Gamble) or absent, narrow, glabrous; *anthers* 14 mm. long with short hairy tips.

DISTRIBUTION: known from four collections from the lowlands of Malacca, Negri Sembilan and Selangor; also from Siam (Katok, Korat, Kerr 8178).

RECORDED MALAY NAMES: Buloh Padi, Buloh Akar.

The long hairy lemma and the long internode below it are distinctive. The culm-sheath is described from the Kew specimen of S.F.N. 28422. I could not find any lodicule in two spikelets dissected in Singapore.

*Specimens:* MALACCA, Sungei Hudang, Ridley 5600 (S,K). NEGRI SEMBILAN, Kuala Pedas, Ridley 10065 (S,K). Bukit Kepayang, Alvins 2167 (S, type). SELANGOR, Bukit Cheraka Forest Reserve, Klang, Pestana S.F.N. 28422 (S,K).

3. **S. jaculans** Holtt. in Kew Bull. 1953, no. 4: 494.

Synonym: *S. blumii* quoad Gamble (p.p.) and Ridley, not of Nees.

*Culms* slender, 6–7 m. long, to 3·5 cm. diameter at the base; longest internode commonly 80 cm., sometimes to 125 cm. long, top of young internode covered with a little waxy powder. *Culm-sheaths* to 30 cm. long, the back bearing copious medium-brown hairs which are not closely appressed (thus easily detached), the top truncate; *blade* green, at first erect, soon reflexed, attached to a slight depression in the top of the sheath, 10–25 cm. long, 7–18 mm. wide; *auricles* hardly 1 mm. high, to about 17 mm. in lateral extent, bearing slender pale bristles 8–12 mm. long; *ligule* hardly 2 mm. high, fringed with fine hairs to 3 mm. long (fig. 12). *Leaf-blades* 12–30 cm. long, 1·2–5 cm. wide, lower surface shortly soft-hairy; petioles of lowest leaves 3–4 mm. long, of upper leaves 5–7 mm.; auricles usually bearing a few slender bristles 4–10 mm. long; ligule short. *Flowering branches* usually leafless, slender, glabrous, bearing spikelets in dense tufts at the nodes; lower internodes 4 cm. long, upper ones 1 cm. long. *Spikelets* 1-flowered, slender, glabrous, usually without any extension of the rachilla beyond the flower (a very slender extension 5 mm. long once seen); bracts below flower to 6 mm. long, mucronate, glabrous; *lemma* c. 10 mm. long, glabrous, shortly pointed; *palea* c. 16 mm. long, the two tips 0·5 mm. long, the back hardly grooved; *lodicules* absent; *anthers* 6–6·5 mm. long, filaments when young joined to form a tube 0·5–1·5 mm. long; *ovary* with the stiff style at flowering 18 mm. long; stigmas 3, purple, 1·5 mm. long; fruit unknown.

DISTRIBUTION: probably wild in the north of Malaya and in the region further north, planted at many places throughout Malaya for use in making blow-pipes; flowering rarely in Malaya.

RECORDED MALAY NAMES: Buloh Sumpitan, Buloh Tĕmiang, Buloh Kasap, Buloh Tikus.

This appears to be the species commonly used throughout the lowlands of Malaya for making blow-pipes (see Holttum, l.c., and remarks under *Bambusa wrayi*), and is doubtless the bamboo referred to by Wray in the footnote in Skeat & Blagden's *Pagan Races of the Malay Peninsula,* Vol. 1, p. 255. Two internodes are necessary for making the inner tube of a blow-pipe; these are very carefully joined, and then they are put into a stronger tube made from a larger part of the same kind of bamboo. The method is described by Skeat & Blagden, p. 281.

This species would be referred to Neohouzeaua by those who maintain that genus (see introductory discussion on Schizostachyum above). When publishing the description of the species in

1953, I overlooked the fact that closely similar bamboos occur in Java, Borneo and the Philippines, and perhaps elsewhere in Malaysia; I also overlooked that fact that flowering specimens had previously been found in Malaya, and had been identified (by Gamble and Ridley) as *S. blumii* Nees. Backer's description of the latter species (*Handb. Fl. Jav.* 2: 285) differs considerably from *S. jaculans* in floral characters, but agrees in shape of culm-sheaths (though Backer says the blades are erect) and in length of internodes. Backer gives as a synonym *Bambusa longinodis*

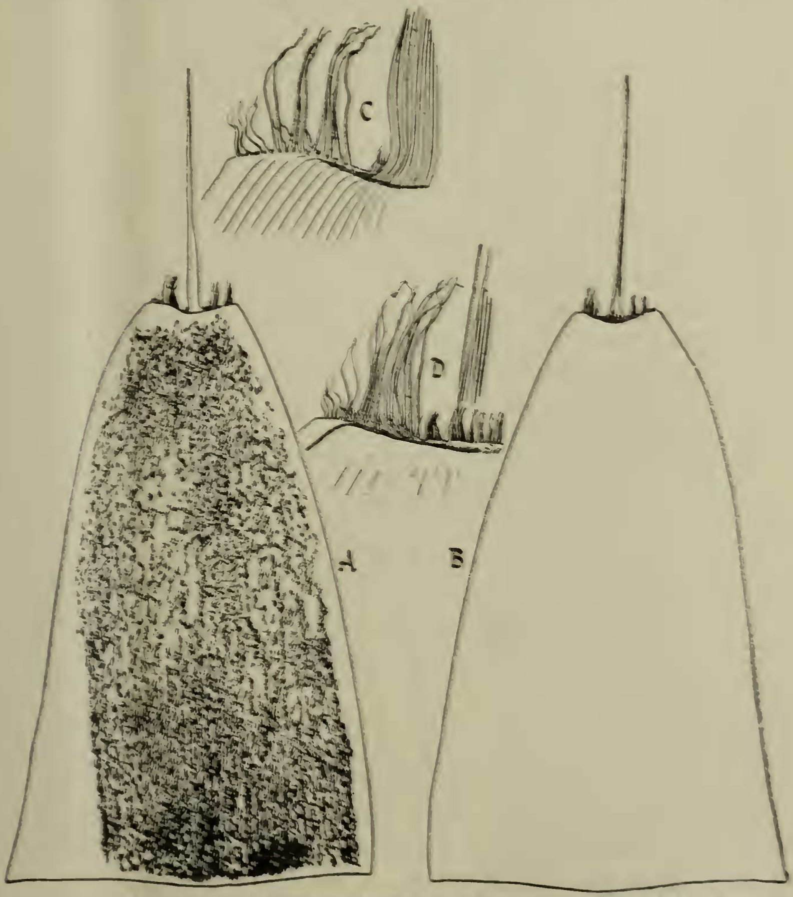

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Fig. 12. Culm-sheath of *Schizostachyum jaculans*. A, outer surface of a complete sheath, the blade moved to an erect position. × 1/3. B, inner view of same. C, outer surface of part of top of sheath, showing auricle bearing bristles with the ligule behind it, and part of the base of the blade, × 4/3. D, inner surface of parts shown in C, showing the short fringed ligule with the long bristles of the auricles behind it.

Miquel, which appears to be based entirely on *Arundarbor spiculorum* Rumph. (Dr. van Steenis and Dr. Lanjouw kindly inform me that no specimens named *B. longinodis* by Miquel can be found in the herbaria at Leiden and Utrecht).

More recently, McClure has examined and described the type specimen of *S. blumii* (*Blumea* 2: 86–94. 1936), and there is no doubt that it is quite different from the species described by Backer. It might seem reasonable therefore to use Miquel's name, transferred to Schizostachyum, for Backer's species; but I think it would be better to regard *Bambusa longinodis* as a *nomen dubium,* because there appears to be a group of species of this alliance. *S. lima* (Blanco) Merrill, in the Philippines, is one of these, and I have seen specimens of another from North Borneo which appears to be unnamed.

Though there is in Borneo a slender Schizostachyum with flowers rather like those of *S. jaculans* (filament-tube present, and no lodicules) there is no indication that this bamboo is used for making blow-pipes. Blow-pipes are used, but they are made by boring pieces of wood. It may be that the Bornean species of Schizostachyum has shorter internodes than *S. jaculans* and is therefore unsuitable. A specimen at Kew has a note that internodes are 18–30 inches long (45–75 cm.); a note on another specimen states that the culms are used for making spears.

*Specimens:* SINGAPORE, Chua Chu Kang, Ridley 6114 (S,K). Bedok, Ridley 13323 (S,K). Seletar, Ridley 445 (S). Chan Chu Kang, Ridley 73 (S). JOHORE, Buloh Kasap, Holttum S.F.N. 38307 (S). Kota Tinggi le Doux s.n. 10.2.1948 (S). MALACCA, Ayer Kroh, Ridley 10769 (K). Vaughan Stevens 3936 (S; sterile, doubtful). SELANGOR, Kepong, Wyatt-Smith F.D. 71511 (K,Kep., type). Bukit Lagong F.R., Kuala Lumpur, Symington F.D. 56740 (Kep.). PAHANG, Near Bentong, A. Rahman F.D. 4061 (Kep.). Pulau Tioman, Henderson S.F.N. 18486 (S); Burkill s.n. 1915 (S). PERAK, Road to Jor, Ridely 13852 (S, doubtful). Cameron Highlands Road, 8th mile, Holttum S.F.N. 38419 (S); 6½ mile, Le Mare s.n. 23.1.1947 (S). Changkat Jong, Holttum S.F.N. 38433 (S).

4. **S. zollingeri** Steud., Syn. Pl. Gram. 332. 1854. Kurz in Journ. As. Soc. Beng. 39 pt. 2: 88, pl. 12. 1870. Backer, Handb. Fl. Jav. 2: 283. Ridley, Flora 5: 269.

Synonym: *S. chilianthum* quoad Gamble in Ann. R. Bot. Gard. Calc. 7: 115 (in part; not *Chloothamnus chilianthus* Buse; see Henrard in Blumea 2: 60. 1936).

*Culms* close, stiffly erect with slender tips only drooping, to c. 15 m. tall; internodes commonly to 40 cm. long and 2–10 cm. diameter. *Culm-sheaths* long persistent, to c. 15 cm. long, very stiff, light brown or flushed with purple near top when young, top rounded (not truncate), back more or less covered with appressed shining dark brown hairs; *blade* rigid, erect, strongly convex, stiffly pointed, flushed with purple when young, broadly trianglar, commonly 7–9 cm. long and wide (lower ones wider than long), slightly narrowed at the base, upper surface pale-hairy; *auricles* to 7 mm. or more high, spreading laterally beyond the width of the top of the sheath (smaller on some plants), their edges bearing very close curved hairy bristles; *ligule* to 4 mm. high, edge smooth or short-hairy (fig. 13). *Leaf-blades* commonly to 30 cm. long and 4 cm. wide, sometimes to 40 by 6·5 cm., or on small shoots only 12 by 1 cm., base cuneate, lower surface glabrous or slightly hairy, more or less rough to the touch, upper surface smooth, petiole broad and c. 5 mm. long; sheath hairy when young; auricles usually well developed and sometimes laterally spreading, with many slender bristles; ligule short. *Spikelets* usually borne in dense tufts at the nodes on the rigid distal part of a leafy branchlet, flowering nodes 1–3 cm. apart. *Pseudo-spikelets* 15–20 mm. long; basal bracts with stiff awn-like points 1·5 mm. long, edges more or less fringed; perfect flower 1, with slender rachilla-extension 5–9 mm. long bearing a very small rudimentary floret; *lemma* 8–9 mm. long, edges slightly hairy near tip; *palea* about 2 mm. longer than lemma, grooved on the back near apex only, apex 2-pointed, edges near apex short-hairy; *lodicules* 3, 2·5–4 mm. long, apex rather broadly triangular and shortly fringed; anthers 3·5–5 mm. long with short blunt tips.

DISTRIBUTION: Java, Sumatra (?); probably throughout Malaya, on edges of forest and in clearings, from Ulu Langat in Selangor northwards, also often planted in villages; does not flower continuously.

RECORDED MALAY NAMES: Buloh Tulo (= telor?), Buloh Telor, Buloh Pĕlang, Buloh Nipis, Buloh Dinding, Buloh Pauh (= Pa-aur?), Buloh Kasap, Buloh Lĕmang, Buloh Aur.

Used for making floors and walls of houses, for rafts, and for cooking rice; probably also for making small implements where a sharp edge is necessary.

The name *S. zollingeri* was given by Steudel to Zollinger's no. 3529 from Java, which I have not seen. I identify Peninsula plants (from which the above description is made) with Steudel's species on the evidence of Kurz and Backer. The above description agrees with Backer's description of Java plants, except that he gives diameter of culm as 1·5–5 cm., lemma 7–8 mm. long and lodicules 1·5–2 mm. long. It is possible that the Java plants represent a different species, in which case the Peninsula ones need a new name. There is variation among Peninsula plants referred here by me in (*a*) extent of hairiness of young culms, which are in some cases very conspicuously glaucous when seen from a distance, in others less so with sparse pale hairs, and (*b*) size of the culm-sheath auricles, which are in some cases rather small (notably in

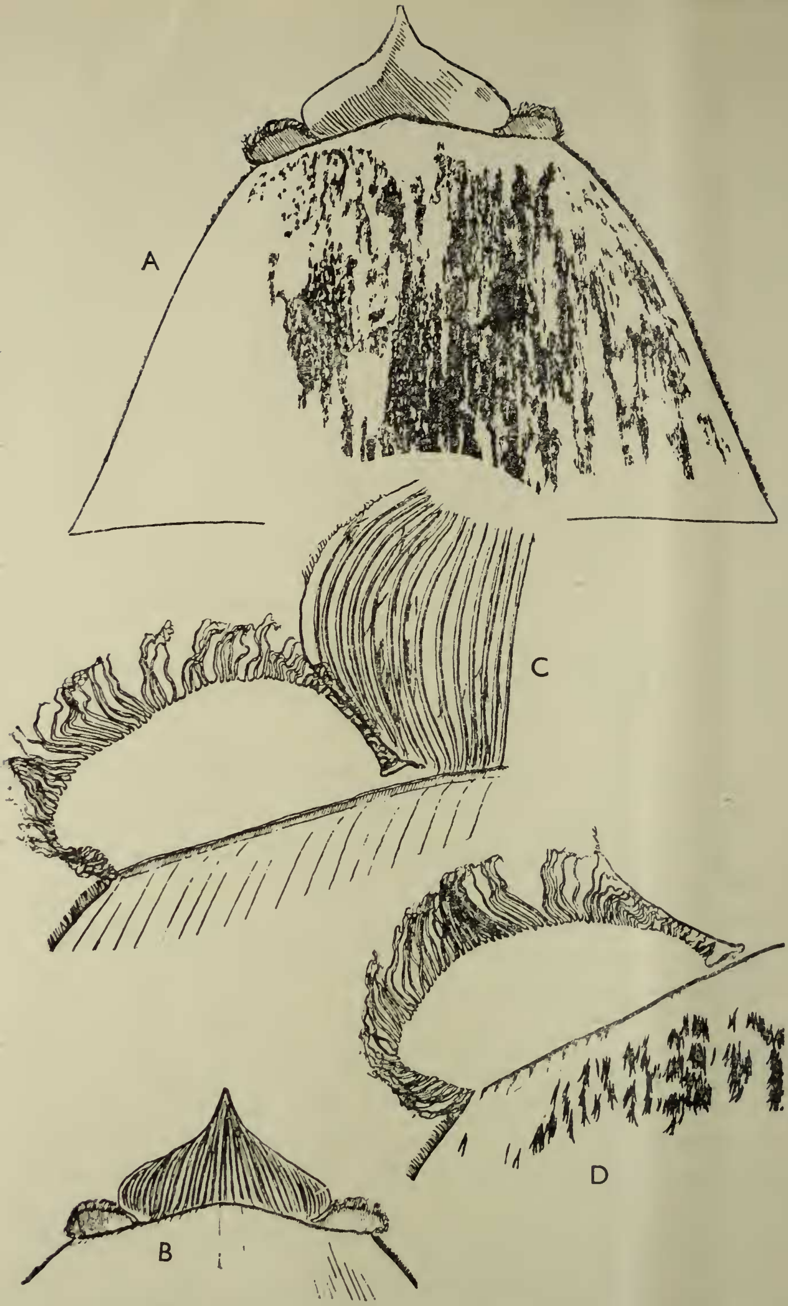

Fig. 13. Culm-sheath of *Schizostachyum zollingeri*. A, outer surface of complete flattened sheath. B, inner surface of blade and top of sheath, to same scale as A. C, inner view of part of top of sheath, showing ligule, auricle and part of blade, × 2. D, outer view of top of sheath and an auricle.

plants seen in forest clearings at Ulu Langat). The peculiar shape of the blade of the culm-sheath, the rounded top of the sheath, and the very dark colour of the hairs on the sheath, are very distinctive, and are well described by both Kurz and Backer.

*Specimens:* SINGAPORE, Bukit Timah Road, Ridley 6111 (K), 6116 (S,K), 10939 (S,K). Yio Chu Kang, Ridley 11293 (K), 11294 (S,K). Ulu Pandan, Holttum s.n. 10.10.1948 (S). Bukit Panjang, Ridley 11850 (S,K). JOHORE, Bukit Muar, Fielding 4420 (S,K). Serom, Ridley 10990 (S,K). Road to Castlewood, Ridley s.n. 1904 (S). Ulu Segaun, G. Panti, Corner S.F.N. 30679 (S,K, doubtful). NEGRI SEMBILAN, Jelebu, Md. Tahir F.D. 9594 (S,K). Pertang, Hussein F.D. 9599 (S,K). 151 mile Ampangan Road, Buyong F.D. 11004 (K). Tampin-Seremban Road, Holttum S.F.N. 38409 (S). Pertang, Pantai and Ulu Klawang, per A. Arber (K). G. Tampin Reserve, Kinsey s.n. (K). No locality, Alvins 1089 (S). SELANGOR, Langat Valley, Holttum S.F.N. 38411 (S). Ginting Simpah Road, Holttum S.F.N. 38414 (S). PAHANG, near Pekan, Burkill & Haniff S.F.N. 17253 (S). PERAK, Grik, Hamid F.D. 6422 (S,K), 8251 (S,K). Semat, Jenal F.D. 8323 (Kep.) S. Kulim, Burkill & Haniff S.F.N. 13811 (S,K). Telok Anson, Pestana S.F.N. 28431 (S).

5. **S. brachycladum** Kurz in Journ. As. Soc. Beng. 39 pt. ii: 89, pl. VI fig. 2. 1870. Backer, Handb. Fl. Jav. 2: 282.

*Habit of S. zollingeri,* but with less drooping culm-tips; culms to 8 cm. diameter, green, or yellow with a few narrow green longitudinal streaks. *Culm-sheaths* long persistent, to c. 18 cm. long, rigid, densely covered with appressed fine red-brown hairs, junction of top of sheath with blade horizontal; *blade* erect, slightly convex, triangular with stiffly acuminate apex, on middle nodes to c. 8 cm. long and 10 cm. wide (base extending to the full width of the top of the sheath); *auricles* rather small, usually 2·5 mm. high (but see var. *auriculatum* below), crisped, bearing crisped bristles 4–5 mm. long; ligule to 2 mm. high, edge smooth (fig. 14). *Leaf-blades* to about 40 by 7 cm., lower surface softly hairy (hairs c. 1 mm. long); auricles usually with several bristles (lacking on upper leaves); ligule low, entire. *Flowering branches* as in *S. zollingeri. Spikelets* 1- or 2-flowered, with slender rachilla-extension bearing rudimentary floret to 6 mm. long (shorter if 2 perfect florets present); rachilla-internode between the 2 perfect florets 4 mm. long; *lemma* 10–12 mm. long including a stiff point 1 mm. long, edges fringed near apex; *palea* 11–14 mm. long, tip very shortly 2-pointed; *lodicules* 3, translucent or purplish, nearly equal, to 5 mm. long, apical halves shortly hairy on and near edges; *anthers* purple, 6 mm. long; *ovary* and style at flowering c. 15 mm. long (fig. 11, A–C).

DISTRIBUTION: Java and Eastern Malaysia; in Malaya often planted as a village bamboo (green culms) or as an ornamental (yellow culms), some plants at least flowering continuously. A specimen of Ridley's, dated 1896, of the yellow variety, has a note "cult. Singapore, said to have come from Borneo".

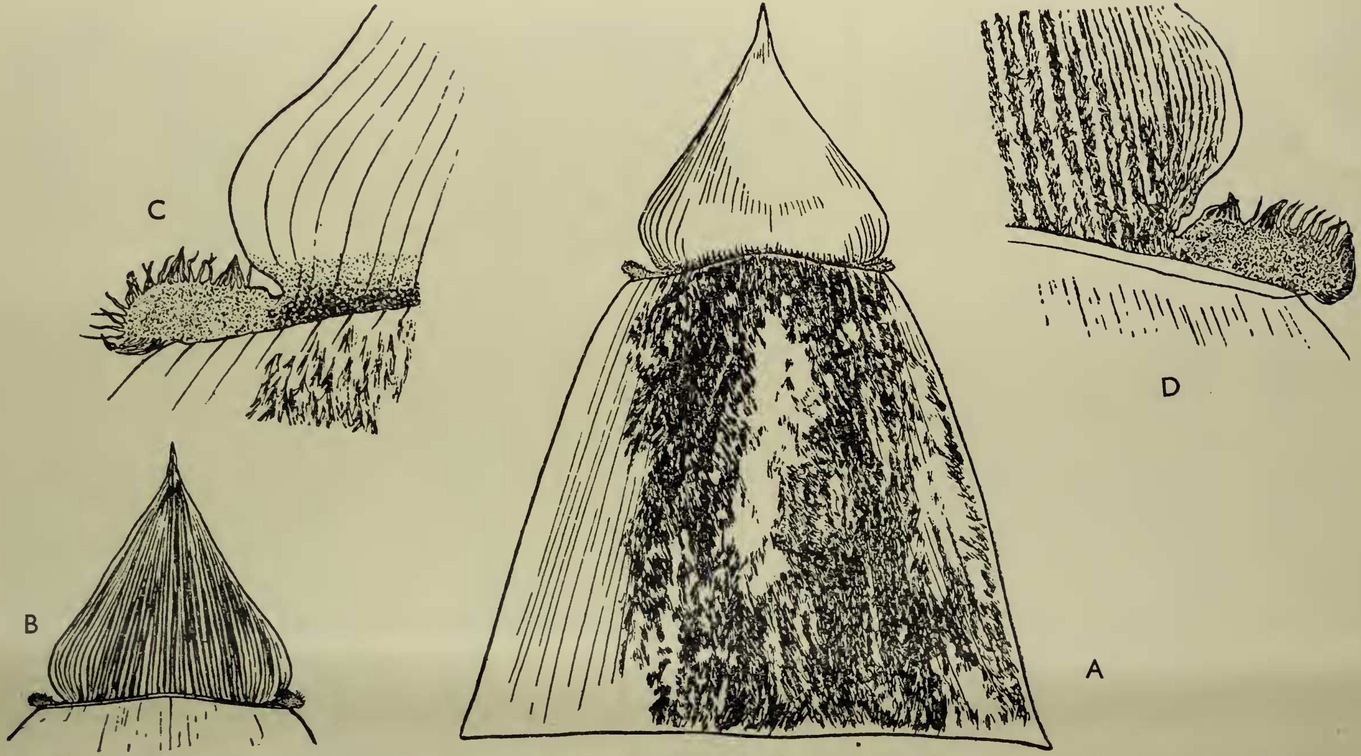

Fig. 14. Culm-sheath of *Schizostachyum brachycladum*. A, outer surface of complete flattened sheath, × 1/3. B, inner view of blade and top of sheath. C, outer view of one auricle with adjacent parts of sheath and blade, × 2. D, inner view showing ligule, inner surface of blade, and of auricle.

RECORDED MALAY NAMES: Buloh Nipis, Buloh Lĕmang, Buloh Padi, Buloh Urat Rusa, Buloh Pĕlang.

The specimens in Gamble's herbarium which I would place under this species were mostly referred by him to *S. zollingeri;* but it is clear from his notes that he was not satisfied as to the distinctions between specimens labelled by him *S. zollingeri* and *S. chilianthum.* It is in fact difficult to name flowering material of these plants, though vegetatively they are very distinct. Gamble did not mention having seen spikelets with two perfect flowers, though such occur on some specimens from his herbarium. Backer also has no reference to two-flowered spikelets. I have found two flowers in specimens from Perak and Kedah, as well as in yellow-culm plants cultivated in Singapore. Of other differences from *S. zollingeri,* I believe that the longer lemma of *S. brachycladum* is generally a good distinction, and the softly hairy leaves. Leaves of some specimens of *S. zollingeri* are however slightly hairy.

*Specimens:* SINGAPORE, Botanic Gardens, Ridley 8086 (S); Burkill s.n. 1.5.1916 (S,K); Md. Nur s.n. 17.8.1918, 27.3.1922 (S); Pestana s.n. 2.6.1933, 28.6.1933, 28.8.1933 (S). Pasir Panjang, Ridley 10381 (S,K). St. John's Island, Ridley 11360 (S,K). Nassim Road, Ridley 12560 (S,K). Blakang Mati, Ridley 12561 (S,K). Mt Echo, cult., Burkill s.n. 24.7.1915 (S,K). JOHORE, Road to Reservoir, Ridley 9177 (S,K). PERAK, Krian, cult., Ridley 9385 (S,K). Ipoh, Ridley 11869 (S,K). Semat, Jenal F.D. 8322 (Kep., K). Taiping, Dolman F.D. 10238 (K,Kep.). Near Taiping, Holttum s.n. 28.10.1946 (S). PAHANG, Kuala Lipis, Marshall F.D. 21377, 21378, 21379, 21382 (Kep., sterile). PENANG, Waterfall Gardens, Md. Nur s.n. 26.9.1918 (S); Pestana s.n. (S). Government Hill, 1,000 ft., Curtis 3792 (S).

**Var. auriculatum** Holttum, var. nov.

Auriculae vaginarum culmorum majores, eis S. zollingeri similes. Singapore, Pasir Panjang, 6½ mile, Kiah, s.n., 11.12.1934 (K, Kep. S).

The type of this variety appears to agree in all characters with normal *S. brachycladum* except for the auricles of the culm-sheaths, which are as big as those of *S. zollingeri.* I have not seen another plant with this character. The type plant is certainly not native in Singapore, and was probably brought from somewhere in Indonesia. Ridley apparently collected specimens from the same plant in 1899 (no. 10381).

6. **S. insulare** Ridl. in Journ. Str. Br. R. As. Soc. 61: 64. 1912. Flora 5: 270.

Vegetatively indistinguishable from *S. longispiculatum;* rachilla-extension 13 mm. long bearing a rudimentary floret 6 mm. long; stamens usually 4, with 2 lodicules.

DISTRIBUTION: only known from the type specimen, from Pulau Rawei in the Butang group, north of Langkawi (Ridley no. 15931; S, K.) Ridley stated that the filaments of the stamens were united to form a tube, but in a spikelet examined by me the filaments of fully expanded stamens appeared to be free. The long rachilla-extension and large rudimentary floret are unlike anything in the various specimens of *S. longispiculatum* examined by me, so that I think *S. insulare* may reasonably rank as a distinct species. It will be interesting to see whether specimens from the mainland north of Malaya are similar, or whether *S. insulare* is confined to the islands.

7. **S. longispiculatum** Kurz in Journ. As. Soc. Beng. 39 pt. ii: 89, pl. VI fig. 1. 1870. Ridley, Flora 5: 270.

Synonyms: *S. latifolium* Gamble in Ann. R. Bot. Gard. Calc. 7: 117. 1896. Ridl. Flora 5: 270.

*Ochlandra ridleyi* Gamble l.c. 127. 1896. Ridley, Flora 5: 272.

*Schizostachyum ridleyi* Holtt. in Gard. Bull. Singap. 11: 296. 1947.

*Culms* erect with slender drooping tops, commonly 1·5–2·5 cm. diameter, 3–5 m. tall, longest internodes 35–55 cm. long, walls 3–4 mm. thick; surface covered with white hairs when young, with a little waxy powder just below the nodes. *Culm-sheaths* 12–14 cm. long, thin, green turning to papery light brown when old, hairs pale, sparse and appressed; *blade* green or pinkish when young, spreading or reflexed, on middle sheaths 6–9 cm. long and 12–17 mm. wide, abruptly narrowed at base to 10–12 mm.; *auricles* on a base c. 10 mm. long, 3–5 mm. high, extending laterally as narrow free lobes 5 mm. beyond the base of attachment, edge bearing bristles 5–10 mm. long; *ligule* 1–1·5 mm. high, very shortly fringed (fig. 3). *Leaf-blades* commonly about 25 by 3 cm., largest seen 40 by 7 cm., lower surface short-hairy when young, petiole 4–8 mm. long; projecting auricles often present like those on culm-sheaths but smaller, bearing bristles 4–7 mm. long; ligule short. *Spikelets* borne in groups at the distal nodes of a branch which is leafy at the base; flowering part of the branch 10–25 cm. long, sometimes with short lateral branches near the base. *Pseudo-spikelets* 22–30 mm. long, slender and terete; basal bracts with spine-like tips, edges slightly fringed; *lemma* 18–21 mm. long including spine-like apex of 2·5–3 mm., surface near apex hairy (hairs spreading); *palea* about 2 mm. longer than lemma, apex with 2 close slender points 1·5–2 mm. long, back hardly grooved; *rachilla-extension* very slender, usually 4–7 mm. long, bearing a rudimentary floret less than 0·5 mm. long; *anthers* 9–10 mm. long, apex very shortly apiculate, the tip sometimes with a few very short hairs, or in some cases the apiculus so reduced that it is overtopped by the tips of the pollen-sacs, the apex thus 2-lobed; one or more stamens sometimes more or less intermediate in structure between a stamen and a lodicule; *lodicules* very variable in spikelets on the same branch, 3–10 in number, unequal, commonly 5–7 mm. long, in two observed cases a single lodicule 18 mm. long.

Distribution: Malaya, Borneo, Western Java (?); in Malaya not uncommon, especially on the edges of forest by rivers, found in all parts of the country.

Gamble noted that his *S. latifolium* differed from *S. longispiculatum* in the presence of lodicules (said to be lacking in *S. longispiculatum*) and in the apiculate anthers. I have found great variation in the lodicules (as noted in the description) and the occasional complete absence of lodicules would not be surprising. As regards the apices of the anthers, I find much variation also in the development of the apiculus (a prolongation of the connective); when it is small, the tips of the pollen-sacs overtop it, and the anther could then be called bilobed. In his original description of *Ochlandra ridleyi,* Gamble noted that three stamens shorter than the rest had a slender hairy apiculus, the others a short blunt one. The specimen which Gamble examined had an unusually large number of lodicules, which is the only reason for regarding it as Ochlandra. In every other respect it is indistinguishable from the type of his *Schizostachyum latifolium.*

*Specimens:* Singapore, Bukit Mandai, Ridley 4620 (S,K, type of *O. ridleyi*). Chua Chu Kang Road, Holttum S.F.N. 38406 (S). Johore, Bukit Muar, Fielding s.n. 1892 (S). Mawai Road, Kota Tinggi, Holttum S.F.N. 38404 (S). Malacca, Tebong, Ridley s.n. Jan. 1917 (K). Negri Sembilan, Johol Woods, Ridley s.n. 17.1.1917 (K). Pahang, Tanjong Antan, Pahang River, Ridley 5598 (S,K). Kota Glanggi, Ridley 5602 (S,K). Kuala Lipis, Machado 11592, 11593 (S,K). Kuala Lipis, Burkill & Haniff S.F.N. 15656 (S). Bentong, river bank, Burkill & Haniff S.F.N. 16423 (S,Kep.). Sungei Cheka, Holttum S.F.N. 24784 (S,Kep.). Kuala Tahan, Holttum s.n. 27.9.1954 (S,K). Selangor, Ginting Bidai, Ridley 7788 (S,K). Batu Tiga, Ridley 11936 (S). Perak, Lumut, Ridley 8389 (S,K), 10322 (S,K). Tanjong Malim, Ridley 11863 (S,K). Tapah, Ridley 14035 (S,K). Cameron Highlands Road, 700 ft., Holttum S.F.N. 38427 (S). Kelantan, Pehi River, Ridley s.n. 3.2.1917 (K). Kuala Krai, Haniff & Nur S.F.N. 10095 (S,K,Kep.).

8. **S. grande** Ridl. in Journ. Str. Br. R. As. Soc. 82: 204. 1920. Flora 5: 271.

*Culms* to at least 20 m. long, to about 12 cm. diameter, erect only when young, usually curved in almost a semicircle and often drooping to the ground when not supported by trees; internodes to 90 cm. long, covered when young with copious white appressed hairs. *Culm-sheaths* to 35 cm. long, when young pale yellow grading to pale green, covered on the back with appressed almost white hairs, line of junction with blade slightly arched, *auricles* very small with rather short slender bristles (5 mm. long); *blade* early deciduous, narrowly triangular (broadly triangular on lower sheaths), erect, dark brown when young, to at least 27 cm. long and 10 cm. wide, stiff, edges inrolled towards apex, base very slightly narrowed, outer surface smooth, upper surface rather densely covered with appressed pale hairs; *ligule* 4–8 mm. tall, irregularly toothed. *Leaf-blades* to 60 cm. long and 10 cm. wide, commonly 50 by 7 cm. (smaller leaves 30 by 4–5 cm.), apex acuminate, base somewhat asymmetric, surfaces glabrous, petiole very stout, 10 mm. long; sheaths often appressed-hairy when young, the top ascending above the attachment of the petiole on either side and joined across by the ligule, auricles small, no bristles seen; ligule to 8 mm. tall above base of leaf-stalk, edge sometimes bearing slender bristles near each end. *Spikelets* in dense groups at the nodes of the distal part of a leafy branchlet, or on leafless branched branches direct from the main culm; mature spikelets c. 3 cm. long, consisting of 3 (or 4?) florets and a rudimentary terminal one, the uppermost perfect floret with tightly rolled lemma and palea, lower florets with loose lemma and palea; *rachilla-internodes* 7 mm. long, slender, widened to the apex, glabrous; *lemma* of lower florets 10–15 mm. long with a short stiff tip, glabrous; *palea* of lower florets 12–17 mm. long, glabrous, very shortly 2-pointed, with a narrow groove down the back; *anthers* 8 mm. long, not apiculate; *lodicules* 3, somewhat variable, 3·5–5 mm. long, narrowly elliptic, short-pointed, shortly fringed; *fruit* 10–12 mm. long, cylindric, abruptly narrowed into a stiff curved beak 15 mm. long.

DISTRIBUTION: one of the commonest gregarious bamboos of open places in the foot-hills of the Main Range, very abundant at Ginting Simpah (2,000 ft.), at the Gap (3,000 ft.) and near the road to Cameron Highlands; found also on Gunong Raya in Langkawi islands at 2,600 ft. (on granite), and in the lowlands of Pahang (near Bentong and Kuala Lipis), Upper Perak (Grik) and Kelantan.

RECORDED MALAY NAMES: Buloh Sĕmĕliang (from several localities), Buloh Sĕminyeh.

The spikelets of *S. grande* have the same structure as those of *Dendrochloa distans* Parkinson from Burma (*Indian Forester* 59: 707. 1933), and I would include the latter species in Schizostachyum. Parkinson's species has much larger spikelets than those of *S. grande* (5–7 much larger florets, and rachilla-internodes 2 cm. long). Parkinson stated that the filaments are partly united (3 together, 2 together and 1 free), but I do not regard this as a difference of generic rank. He also stated that the pericarp is adherent to the seed, and therefore thought his genus should be near Bambusa. I have examined dried fruits of the type specimen, and find that when soaked the thin pericarp can be detached from the seed, as in Schizostachyum; the structure of the fruit is exactly like that of *Schizostachyum gracile*.

*Specimens:* SELANGOR, Ginting Bidai, Ridley 7787 (K,S). Pahang Track, 15th mile, Ridley 8457 (S,K); Machado 11591 (S,K). Semangkok Pass, Ridley 12043 (Type, S,K); Ridley s.n. 21.1.1921 (K). Near Gap, Burkill F.D. 7774 (S); Strouts F.D. 10458 (Kep.); Symington F.D. 20162 (Kep.,S); Curtis 3745 (S,K). Ginting Simpah, Holttum S.F.N. 38412 (S). PAHANG, Kuala Lipis, Somerville F.D. 10489 (K); Marshall F.D. 21380, 21384 (Kep.). Raub Road, Best S.F.N. 14120 (S). Bentong, Burkill & Haniff S.F.N. 16490, 16598 (S). Chigar Perah, Henderson S.F.N. 22585 (S). Gunong Tahan, Wray & Robinson 5550 (S). PERAK, Grik, Hamid F.D. 6423 (Kep.,S), F.D. 8257 (S.K), F.D. 8896 (Kep.). KELANTAN, Ulu Nenggiri, Symington F.D. 51656 (Kep.). Kelumpur, Haniff & Nur S.F.N. 10389 (S,K,Kep.). KEDAH, Gunong Raya, Langkawi, Corner & Nauen S.F.N. 37993 (S,Kep.).

9. **S. terminale** Holtt. in Gard. Bull. Singap. 15: 274. 1956.

*Culm* in type specimen 1 cm. diameter. *Culm-sheaths* 13 cm. long, thin, with rather sparse pale appressed hairs, top of sheath at junction with blade almost triangular, (with rounded apex), junction of sheath and blade not sharp; *auricles* continuing downwards the sides of the triangle, about 5 mm. in lateral extent and 2 mm. high, bearing close curved pale hairs 5 mm. long; *blade* erect, narrowly triangular, about 8 cm. long and hardly 1 cm. wide at base, edges inflexed; *ligule* short. *Leaf-blades* 16–20 cm. long, 2·7–4·2 cm. wide, stalks of upper ones 3–4 mm. long, surfaces glabrous; ligule short; auricles sometimes with bristles to 5 mm. long. *Spikelets* terminal on leafy branches, slender, terete, 4–5 cm. long, with about 4 perfect florets and 1 or 2 imperfect ones above them; basal rachilla-internode 4 mm. long, other internodes to 7 mm. long; *lemma* smooth, 15 mm. long including a slender tip 1 mm. long; *palea* a little longer, its keels well developed, very shortly and stiffly hairy, ending in free tips 0·5 mm. long; *lodicules* 3, 5 mm. long, one 2 mm. wide and symmetrical, the others a little narrower and asymmetric, translucent, with many veins in the basal 2/3, apical part minutely punctate, edges not fringed; *stamens* not seen; *style* at flowering a little longer than the palea; immature fruit 10 mm. long, bearing the persistent style, the whole 25 mm. long.

DISTRIBUTION: only known from the type specimen, collected at Inchong Estate, on the edge of the Sungei Krian in South Kedah (Nauen, S.F.N. 35831, S,K).

The spikelet-structure of this species resembles closely that of *S. grande* Ridl., the only clear difference being the ciliate keels of the paleas. In the spikelet examined by me the apical part was not fully developed; there appeared to be two imperfect florets separated by a short rachilla-internode, but further growth might result in the development of the penultimate floret. Vegetatively the species is very much smaller than *S. grande*. The most striking difference however, if it proves constant, is the production of spikelets singly at the apices of leafy branches. It is possible that other spikelets may be produced later in the axils of bracts at the bases of the first ones, but I see no evidence of this in the type collection.

## BAMBUSA

**Bambusa** Schreber, Gen. Plant. ed. 8, 1: 236. 1789.

Type species: *Bambos arundinacea* Retz., Obs. Bot. 5: 24. 1789. McClure in Blumea Suppl. 3: 90–109. 1946. Holttum in Taxon 5: 26–28, 65–67. 1956.

*Culms* erect, or in some mountain species climbing or needing support from other plants, stout or slender, closely or fairly closely tufted, in a few species slightly zig-zag; *culm-sheaths* often with well-developed bristly auricles. *Spikelets* in groups of few to many (of unequal age) at the nodes of flowering branchlets which may bear leaves in their basal part; *rachilla* jointed at the base of each fertile lemma, the internodes commonly 2 mm. or more long; basal *bracts and glumes* several, one or more with axillary buds, the upper 1–3 without buds; *flowers* 2 to many, uppermost 1 or 2 usually imperfect; *lemmas* broad and many-veined; *paleas* 2-keeled, of firmer texture than in Gigantochloa and with broader inflexed edges; *lodicules* 2 or 3, one smaller than the others, usually fringed; *stamens* 6, filaments usually free (forming a tube in *B. heterostachya*), anthers sometimes apiculate or with a tuft of hairs at the top; *ovary* hairy at the apex, with a long or short style and 1–3 slender hairy stigmas; *fruit* more or less cylindric with a hairy top, slightly grooved on the side towards the palea (groove is on line of the hilum), pericarp somewhat fleshy and separable from the seed at the top, otherwise thin but at least sometimes separable from the seed in a fresh condition, embryo small, basal, its position seen through the thin pericarp.

This is a genus of many species, widely distributed in tropical and subtropical Asia, with a few species native in Malaysia. It is nearly allied to the tropical American genus Guadua. In Malaya two exotic species are commonly planted and a few others less commonly, there are two native lowland species, and on the mountains four or five slender or climbing native species are also known.

The characteristic feature of the spikelets is the jointed rachilla, with distinct and often long internodes, the lemmas all being of equal length (except the rudimentary one at the top of the spikelet); in these characters Bambusa differs from Gigantochloa, which has very short rachilla-internodes and the upper lemmas progressively longer. Some of the mountain species of Bambusa have spikelets with a reduced number of flowers; in *B. klossii* there is sometimes only one perfect flower, and always one in *B. wrayi.* It is possible that the mountain species of Malaya (and with them *B. cornuta* Munro of Java) could be separated as a distinct genus; but at present I do not see a clear separation, and I am not sure that *B. wrayi* and *B. pauciflora* are closely related.

In *B. ridleyi* two of the very large lodicules have a very much swollen fleshy base; whether this is general in the genus, I do not know, as it is a character not clearly shown by dried specimens. The ovary always has a rather fleshy hairy top, bearing the style and stigma; this top is sometimes wider than the glabrous cylindric ovary which bears it, and the latter is sometimes called a stalk. The style varies in length. The fruit structure, seen by me in fresh material of *B. tulda,* does not differ significantly from that of Gigantochloa.

In proposing the generic name Bambusa, Schreber gave a generic description only, and cited no species (not even *Arundo bambos* Linn.). In the addenda to his second volume he referred to Bambos Retzius as a synonym, again without mentioning a species, but as Retzius did describe the species *Bambos arundinacea* (and no other), that must be the type species of the genus. The names Bambusa and Bambos were published in the same year, and I have seen no evidence as to which was in fact earlier; it is customary to accept Bambusa as the correct name.

When describing the new genus Bambos, which he saw was something quite different from Arundo, Retzius quoted the name "*Arundo bambos* auctorum" as a synonym. It might be argued that this meant that he regarded his species as synonymous with *Arundo bambos* Linn., and therefore the meaning of this latter name must be considered. Linnaeus gave no description in 1753, but quoted several former botanical works, two of them his own. The only specimen which can be associated with any of these earlier descriptions is almost certainly *B. vulgaris;* but it is probable that another of the descriptions cited refers to the bamboo here called *B. arundinacea.* I have therefore argued that the name *Arundo bambos* L. should be regarded as a *nomen confusum* and ignored. Fortunately the type specimen of *Bambos arundinacea* Retz. has lately been discovered, so that the type species of the genus Bambusa can be clearly established. For further discussion, see the note on *B. arundinacea* in the following account of the species, and the publications there cited.

**Field Characters.** The species here included in Bambusa are so diverse vegetatively that it is impossible to give any vegetative character as distinctive of the genus. The really common species (*B. vulgaris,* in every village and often on river banks, and *B. glaucescens* in hedges throughout Malaya) are individually quite distinctive; notes on habit are given under each in the account which follows. The thorny bamboos are also at once recognizable from their copious spreading low thorny branches; the distinctions between the two species are given in the key. The common mountain species is a slender, more or less erect, tufted bamboo of high ridges (*B. magica*). The remaining three (or four) mountain species have slender culms not strong enough to support themselves, and seem to be local. Of these, *B. wrayi,* used for blow-pipes because it has slender internodes up to 200 cm. or more long, appears very different, both vegetatively and in spikelet structure, from *B. pauciflora, B. montana* and *B. klossii;* these last three are certainly closely allied and perhaps show relationships to Dinochloa.

In addition to the species here described, *B. tulda* has long been in cultivation in the Botanic Gardens, Singapore. There were formerly two old plants of it. One flowered about 1940 and died, leaving a few seedlings in the adjacent area. The other flowered a little on leafy branches of all its culms over a period of at least six years, gradually dwindling in size, and finally died also.

**Uses.** The larger species have culms which are strong and useful for structural purposes. Hildebrand states that those of *B. vulgaris* are much inferior in durability to those of *B. arundinacea* but as *B. vulgaris* is so abundant in Malaya, being in fact the common large bamboo in villages everywhere, I think its culms are often used. As judged by a section as seen with a hand-lens, the structure of the walls in *B. vulgaris* is much like that of a Gigantochloa, but I believe that *B. vulgaris* does not split so well for basket-making as Gigantochloa. *B. heterostachya* may turn out to be a not uncommon village bamboo in the Malacca region; a collector has noted that it is good for baskets, and (if I am right in identifying with it a bamboo seen near Teluk Anson) it is sometimes used for splitting into strips for other purposes.

The young shoots of *B. vulgaris* are said to be of good edible quality; in fact, Hildebrand says that this is their chief use in Java. The longest internodes of *B. wrayi,* a very local species, are used for making blow-pipes by those forest peoples who have access to them. *B. magica* has been credited with magic properties (being called Buloh Pĕrindu), but Burkill suggests that other bamboos may have been so used also.

**Key to the Malayan species of Bambusa (native and cultivated)**

Culms bearing many thorny branches at the lower nodes

Culm-sheaths with a bristle-edged auricle on each side of base of blade; ligule with stiff bristles irregularly along its edge .. .. .. 1. *B. blumeana*

Culm-sheaths with very hairy blade gradually decurrent each side along top of sheath, decurrent part crisped and not auricle-shaped; ligule 2 mm. tall with fringe of fine hairs 3 mm. long 2. *B. arundinacea*

Culms not bearing thorny branches from lower nodes

Stout tall bamboos (to at least 6 cm. diameter); culm-sheaths with broad erect blades and distinct bristly auricles

Culms plain green, or pale yellowish with a few narrow green streaks; culm-sheath ligule to 3 mm. tall, not bristly on edge

Culm-sheath ligule 1 mm. tall; leaves glaucous and short-hairy beneath 3. *B. burmanica*

Culm-sheath ligule 3 mm. tall; leaves glabrous beneath .. .. 4. *B. vulgaris*

Culms closely and narrowly streaked dark and light green; culm-sheath ligule to 6 mm. tall bearing a fringe of bristles .. .. 5. *B. heterostachya*

Slender bamboos (usually not over 2·5 cm. diameter); culm-sheaths otherwise

Cultivated bamboos

Leaves very finely hairy beneath, not variegated

Leaves pale blue-green beneath; common hedge bamboo with culms not over 2 cm. diameter 6. *B. glaucescens*

        - Leaves not pale blue-green beneath; often grown as a pot plant, with dwarfed culms and short swollen internodes; if in open, culms normal, to 4 cm. diameter . . . . 7. *B. ventricosa*
      - Leaves glabrous beneath, variegated 8. *B.sp.*
    - Wild bamboos, in forest only
      - Leaf-auricles 4–10 mm. tall, bearing bristles to 20 mm. long; lowland forest . . . . . . 9. *B. ridleyi*
      - Leaf-auricles and their bristles much shorter; mountain plants
        - Longest internodes of culm to 200 cm. long . . . . 10. *B. wrayi*
        - Longest internodes much shorter
          - Erect tufted bamboo of mountain ridges; lateral branches in dense tufts; spikelets with several perfect flowers 11. *B. magica*
          - Slender bamboos, not stiffly erect; upper parts of culms climbing and trailing, branches few; spikelets with 1 or 2 perfect flowers
            - Spikelets 10–12 mm. long, always with 2 perfect flowers, keels of paleas smooth; below each node a band of appressed white hairs . . . . 12. *B. pauciflora*
            - Spikelets 7–9 mm. long, sometimes with only 1 perfect flower; keels of palea fringed; hairs below node scattered, not forming a continuous band
              - Fringe on palea very short; fringe on lodicules hardly 0·5 mm.; smaller leaves hairy . . 13. *B. montana*

Fringe on palea longer; fringe on lodicules longer; smaller leaves not hairy .. 14. *B. klossii*

1. **B. blumeana** Schult., Syst. Veg. 7: 1343. 1830. Gamble in Ann. R. Bot. Gard. Calc. 7: 50, pl. 47. Ridl. Flora 5: 256.

Synonym: *B. spinosa* Bl. ex Nees in Bot. Zeit. 1825: 580. Backer, Handb. Fl. Jav. 2: 267. (Not *B. spinosa* Roxb. ex Buch. Ham. 1822).

*Culms* tall, to about 10 cm. diameter, growing close together; internodes glabrous when young; lateral branches borne at nearly all nodes to the base, the lower branches spreading horizontally and bearing stout curved spines in groups of 3 (the middle one longer than the others and sometimes branched again), upper branches branched at the base, obliquely ascending. *Culm-sheaths* to 30 cm. long, the back covered with loose dark brown hairs; *blade* of middle sheaths more or less reflexed, more than half as long as sheath, narrowly ovate (quite narrow on upper sheaths) and stiffly acute, convex on the back when old, back at first densely hairy but glabrous when old, upper surface with more or less persistent dark hairs in longitudinal rows, base constricted and narrowly joined laterally to comparatively small stiff *auricles* bearing stiff curved bristles on their edges; *ligule* stiff, to 5 mm. tall (individed part), the middle tallest and shortly fringed, the outer parts with stiff bristles to 12 mm. long (fig. 15). *Leaf-blades* to about 20 by 2 cm. (on upper branches more usually 15 by 1·5 cm.), base truncate or very broadly cuneate above the short stalk, lower surface not glaucous, sometimes short-hairy towards the base; auricles small, sometimes bristly; ligule short, sometimes with stiff bristles towards the ends. *Spikelet-groups* 1–5 cm. or more apart; *spikelets* to 4·5 cm. long, the hairy rachilla zig-zag and distinctly visible between the florets, its internodes 4 mm. long; *florets* 5–12 (Backer); *lemmas* 6–8 mm. long, glabrous; *paleas* about same length as lemmas, keels strongly fringed, 3–5 veins between the keels; *anthers* 4–5 mm. long; *style* short, stigmas 3.

DISTRIBUTION: native in Java and eastern Malaysia (planted in Indochina?); sometimes planted in Malaya.

RECORDED MALAY NAME: Buloh Duri.

Flowering of this species is apparently rare in Malaya. A plant flowered in Singapore in 1933, the only occasion on which I have seen flowers. A large plant in the Waterfall Garden, Penang, was never seen to flower in the period 1922–1940. There is no evidence that this species ever dies after flowering, as *B. arundinacea*

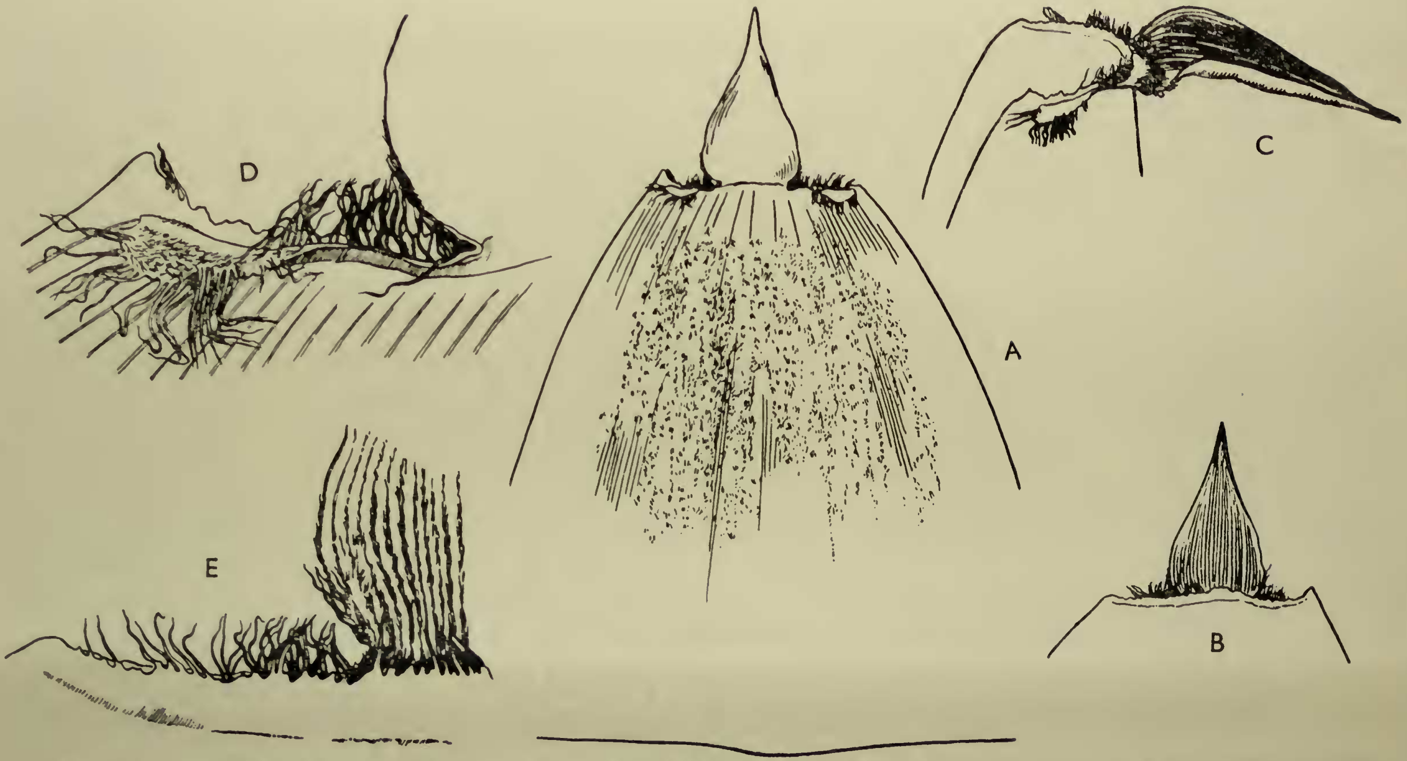

Fig. 15. Culm-sheath of *Bambusa blumeana*. A, outer surface of complete flattened sheath, × 1/3. B, inner surface of blade and top of sheath. C, top of sheath, with blade, in natural position. D, outer view of one auricle with adjacent parts of sheath and blade, × 2. E, inner view of part of top of sheath, showing ligule,

does. There are plants at the Forest Research Institute, Kepong.

Though very similar to *B. arundinacea* in its thorny branches, the present species can be easily distinguished by its culm-sheaths, as indicated in the key. Hildebrand says that *B. blumeana* does not grow so large as *B. arundinacea*, nor are its culms so durable. They are however superior to those of *B. vulgaris*.

McClure has described *B. dissimulator* from Honam Island, Kwangtung, a species very similar to *B. blumeana* in culm-sheaths and spikelets (Lingnan Sci. Journ. 19: 413: 1940).

*Specimens:* SINGAPORE, Botanic Gardens, Ridley 3946 (S, K); Ridley s.n. 1894 (K); Pestana s.n. May 1933 (S). PAHANG, Pekan, Ridley s.n. 1889 (S).

2. **B. arundinacea** (Retz.) Willd., Sp. Pl. 2: 245. 1799. Gamble in Ann. R. Bot. Gard. Calc. 7: 51, p. 48.

Basonym: *Bambos arundinacea* Retz., Obs. Bot. 5: 24. 1789. Roxb., Pl. Corom. 1: 56, t. 79. 1798. Holtt. in Taxon 5: 65–67. 1956.

Synonym: *Bambusa bambos* auctt., supposedly based on Arundo bambos L., a *nomen confusum* (Holtt. in Taxon 5: 26–28. 1956).

*Culms* to 25 m. tall, to 12 cm. diameter, with branches from all nodes from the base upwards, lower branches slender, spreading and thorny as in *B. blumeana*, upper branches rather slender, with few, not crowded, secondary branches. *Culm-sheaths* 20–40 cm. long, back brown-hairy when young, often quite hairless when old; *blade* of middle sheaths more or less reflexed, less than half as long as sheath, commonly about 12 cm. long and 6 cm. wide above the constricted base which widens below the constriction almost to the full width of the top of the sheath, this widened part (constituting the *auricles*) very much crisped and sometimes bearing stiff marginal bristles, its outer parts not auriculiform; lower surface of blade hairy when young, upper surface very densely persistently hairy with a continuous pile of dark short harsh hairs (hairs also on inner surface of auricles); *ligule* to 2 mm. tall, with in addition a fringe of fine hairs to 3 mm. long (fig. 16, 17) *Leaf-blades* variable in size, in Singapore commonly about 12 cm. long and 12 mm. wide, recorded in Java as 4–20 cm. long and 9–25 mm. wide, slightly glaucous beneath, glabrous; auricles small, bearing a few bristles; ligule short, entire. *Spikelets* about 2 cm. long when mature, with 3–6 florets; rachilla-internodes 3 mm. long, usually not visible between the lemmas, hairy below each floret; *lemmas* 7–8 mm. long, glabrous; *paleas* usually a little longer than lemmas, with strongly fringed keels; *lodicules* 3, 2–2·5 mm. long, slightly fringed; *anthers* 5 mm. long; *style* short, stigmas 3.

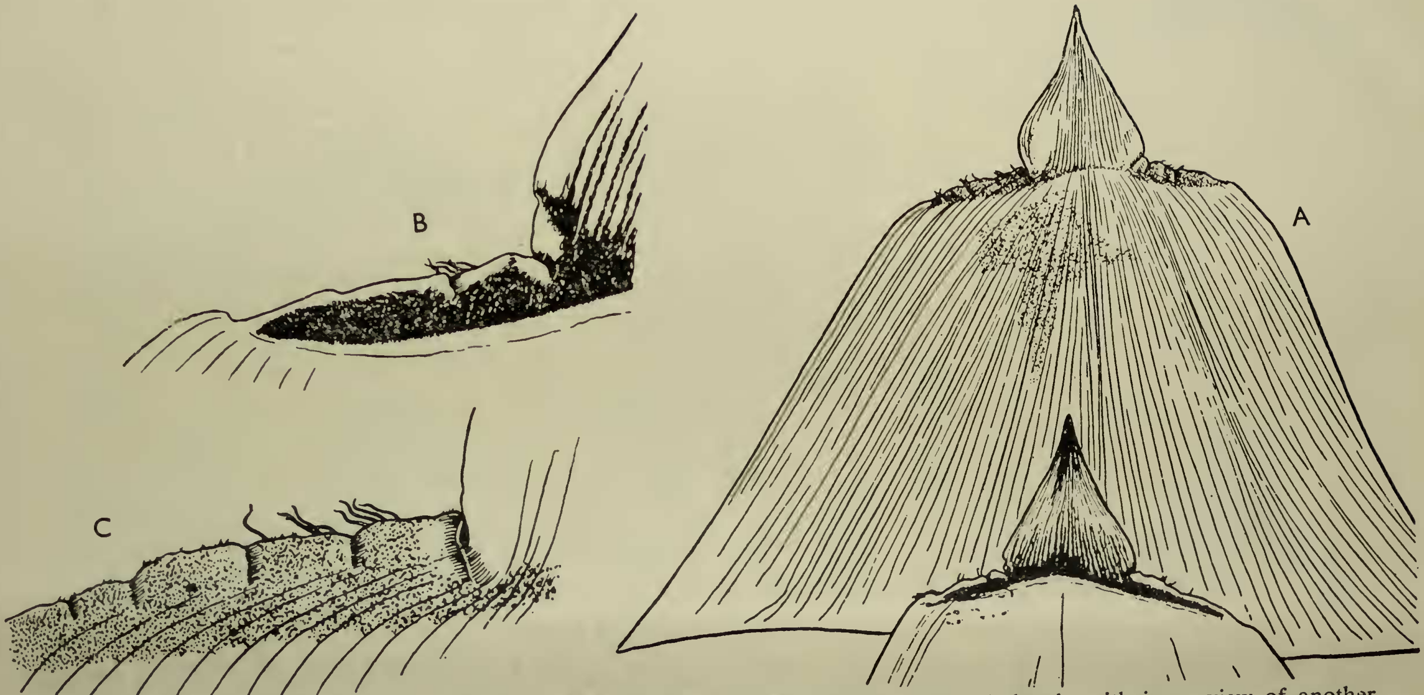

Fig. 16. Culm-sheath of *Bambusa arundinacea*. A, outer surface of a complete flattened sheath, with inner view of another sheath superposed at its base, × ½. B, inner view of part of top of sheath, showing the low ligule against the dark-hairy inner surface of an auricle and base of blade, × 2. C, outer view of auricle.

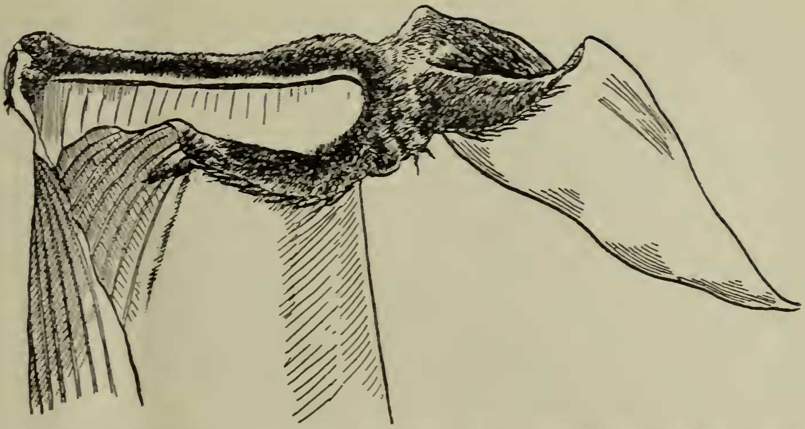

Fig. 17. *Bambusa arundinacea,* top of culm-sheath and blade in natural position, × 2/3.

Distribution: almost throughout India, and in Burma; not commonly planted in Malaya but much planted in East Java; grows well in Singapore. (The common thorny bamboo of Kwangtung is a nearly related but apparently distinct species, *B. sinospinosa* McClure, Lingnan Sci. Journ. 19:411.1940).

As grown in Singapore, this species has larger straighter culms than *B. blumeana,* more open branching, and narrower smoother leaves; the most distinctive features are shown by the culm-sheaths. A large clump in Singapore has not been known to flower. In 1937–38 several large clumps in the Waterfall Garden and at the Residency, Penang, began to flower; they flowered on every new culm for the next three years, without producing any leaves, and finally all died. In India, plants of this species flower when about 30 years old, the flowering in any one district being gregarious; the grains are sometimes collected as food. Backer reports that flowering in Java is rare.

Hildebrand states that the culms are very durable, equalling *Gigantochloa apus* in this, and larger. Further planting experiments in Malaya are desirable, if possible with material from Java; the species is reported as variable in India, and introductions thence might not yield the variety best suited to Malaya. It is doubtful whether *B. arundinacea* occurs in Malay villages.

The name *Bambusa bambos,* supposedly based on *Arundo bambos* L., has been used for this species in recent years by various authors. It is almost certain however that Linnaeus based his species in part on a specimen of the species later called *B. vulgaris.* I have discussed this matter elsewhere (Taxon 5: 26–28) and have shown that *Arundo bambos* L. should be regarded as a *nomen confusum* and therefore ignored. The true identity of *Bambos* *arundinacea* Retz. has also been in doubt, but has been decided by the recent discovery of the type of the species in the Retzius Herbarium at Lund. This shows that Retzius had specimens of both the bamboo above described and *B. vulgaris,* and it is evident that he described the stamens at least from the latter. In such cases it is necessary to select one of the two specimens as the type of the species, and I have proposed that the specimen representing the thorny bamboo should be the type, thus permitting the continued use of the name in the sense in which it was used from the time of Roxburgh onwards until quite recent years. Roxburgh also described a second thorny bamboo which he called *B. spinosa* Roxb. (not to be confused with *B. spinosa* Bl.), but Gamble united the two under the earlier name *B. arundinacea.*

*Specimens:* PENANG, Residency garden, Abdul Kadir S.F.N. 36177 (S,Kep.); Cheang Kok Choy S.F.N. 37940 (S). Waterfall Garden, Bamboo no. 7 and 11, Pestana s.n. (S). SINGAPORE, Botanic Gardens, several collections, Pestana s.n. (S).

3. **B. burmanica** Gamble in Ann. R. Bot. Gard. Calc. 7: 35, pl. 33. 1896.

*Culms* fairly large, exposed parts of young internodes bearing numerous spreading stiff short pale hairs and some appressed dark hairs, also a little white waxy powder below the nodes. *Culm-sheaths* green when young, the back covered with dark hairs towards the base, top much upcurved at junction with blade; *blade* erect, rather broadly triangular except on uppermost sheaths, base almost cordate, apex acuminate, green turning light brown when old, upper surface hairy at the base only; *auricles* spreading much beyond sides of the sheath, 15 mm. long horizontally and 7 mm. high, edges with curved slender pale bristles 10 mm. long; *ligule* 1 mm. tall, dark, edge slightly toothed. *Leaf-blades* to 20 cm. long and 2·5 cm. wide, lower surface blue-green and finely short-velvet-hairy, stalk to 4 mm. long; auricles small, lower ones sometimes produced laterally, none seen bearing bristles; ligule hardly 1 mm. tall. *Spikelets* (fide Gamble) with 5 or 6 perfect florets; ovary with swollen hairy top, style very short, stigmas 3.

DISTRIBUTION: Burma, northern Malaya.
RECORDED MALAY NAME: Buloh Aoh Bukit.

The above description was made from a plant found by me in a bamboo thicket near the road to Sintok in northern Kedah (specimen in H.S.). The plant was not flowering. The culm-sheaths match those of *B. burmanica* very closely, and also the glaucous hairy lower surface of the leaves.

4. **B. vulgaris** Schrad. in Wendl., Collect. Pl. 2: 26, t. 47. 1810. Gamble in Ann. R. Bot. Gard. Calc. 7: 43, pl. 40. Backer, Handb. Fl. Jav. 2: 273. Ridley, Flora 5: 256. McClure in Blumea Suppl. III: 108.

*Culms* not closely tufted, 10–20 m. tall, slightly zig-zag, at the base 5–10 cm. diameter, walls 7–15 mm. thick, nodes prominent; internodes 20–45 cm. long, when young with appressed dark hairs and also scales of wax, when old smooth and shining. Lower *culm-sheaths* short, upper ones on well-grown culms 30 cm. or more long, back densely covered with appressed nearly black loose hairs, top slightly rounded at junction with blade; *blade* yellowish when young, erect or bent back, rarely quite reflexed even on the upper sheaths, dark-hairy on both sides when young, hairs near base on upper surface most persistent, rather broadly triangular (middle sheaths) and stiffly pointed, edges crisped towards the more or less cordate base which is connected laterally with a pair of *auricles* 1 cm. or more high, their edges bearing pale stout curved bristles 7 mm. or more long; *ligule* 3 mm. tall or rather more, edge slightly crisped and very shortly hairy (fig. 18). *Leaf-blades* 9–30 cm. long, 10–40 mm. wide, glabrous, stalk short; auricles small and firm, sometimes with a few bristles; ligule 1–2 mm. high. *Spikelet-groups* 2–6 cm. apart, few in a group on the smaller branchlets; mature *spikelets* 20–35 mm. long, laterally flattened, 4–5 mm. wide; *florets* 5–10, lower rachilla-internodes short, upper ones 1·5–3 mm. long; *glumes* 1 or 2, stiffly pointed, short-hairy towards the apex; *lemmas* 8–10 mm. long, short-hairy on the edges near the stiffly pointed apex; *paleas* a little shorter than lemmas, keels hairy; *lodicules* 3, long-hairy, 2–2·5 mm. long; *anthers* 6 mm. long, with a small tuft of short hairs at the tip; *style* slender, 3–7 mm. long; with 3 short stigmas.

Distribution: cultivated throughout the tropics and probably the commonest village bamboo in all parts of Malaya, often abundant on river banks; origin unknown.

Recorded Malay names: Buloh Minyak, Buloh Minyak Aao, Buloh Aao Beting, Buloh Pau.

**Var. striata**

Basonym: *B. striata* Lodd. ex Lindl. Penny Cyclop. 3: 357. 1835. Hook. fil. in Bot. Mag. t. 6079. 1874.

Culms pale yellow with a varying number of narrow longitudinal green streaks, otherwise as the typical green form but possibly less robust. Occasional in Malay villages.

Recorded Malay names: Buloh Gading, Buloh Aao Gading (ivory bamboo).

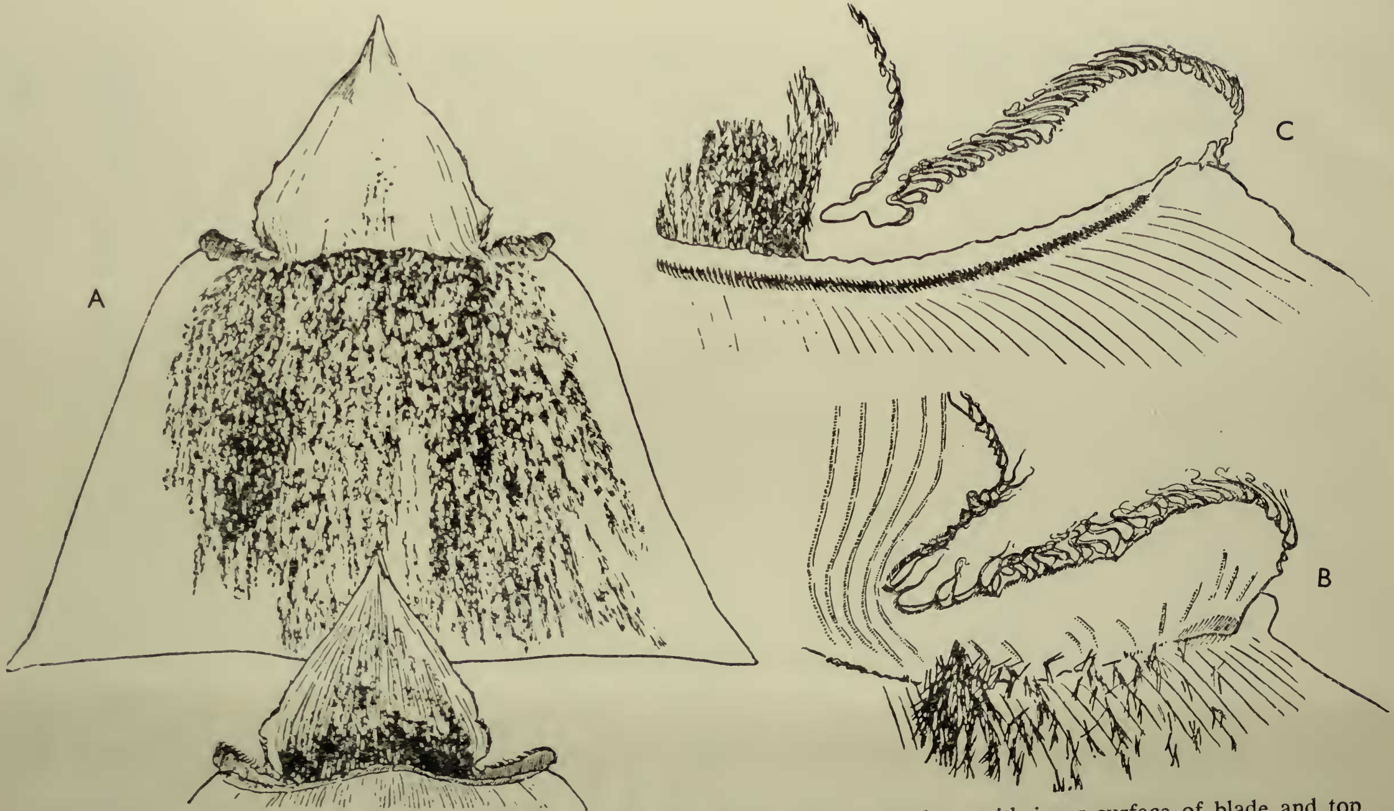

Fig. 18. Culm-sheath of *Bambusa vulgaris*. A, complete sheath, flattened, outer surface, with inner surface of blade and top of another sheath superposed. B, outer view of one auricle and adjacent parts of blade and sheath. C, inner view of part of top of sheath, showing ligule, auricle and part of blade, × 3/2.

Hildebrand states that in Java there is also a variety with green culms having yellow streaks of varying width; I have not seen this in Malaya, and it appears not to have a distinctive varietal name.

**Uses.** Hildebrand states that in Java *B. vulgaris* is chiefly valued for its edible shoots, which are of good quality. He states that the culms are not much valued, being less durable than those of the thorny bamboos and of the best Gigantochloas. But as this species is so abundant in Malaya, it is probably used a good deal for structural purposes, especially of a temporary nature. The slightly sinuous shape of the culms may be a disadvantage for some purposes; this character and the fact that the culms do not grow very close together (as do those of most other village bamboos) is often sufficient to distinguish plants of this species when the very characteristic young culm-sheaths are not showing.

Hildebrand also notes that pieces of culms of *B. vulgaris* root very easily, and often clumps of this species on river banks have grown from posts set in the banks for mooring boats or other such purpose. This may in part explain the abundance of large clumps of *B. vulgaris* on river banks in Malaya. Flowering in Malaya is not common; no fruits have been recorded.

*Specimens:* SINGAPORE, Colonial Secretary's garden, Ridley 5599 (S,K). Botanic Gardens, Ridley 6115 (S,K), 6545 (S,K), 6679 (S,K), 8079 (S,K), 8565 (S), 8899 (S,K), 8949 (S); Md. Nur & Pestana, several sheets from different plants (S). PERAK, Grik, Hamid F.D. 6421 (S,Kep.), 6426 (S,Kep.), 6428 (S,Kep.), 7923 (K) 8255 (S,K). Blanja, Wray 141 (S,K). Taiping, Wray 5625 (S).

5. **B. heterostachya** (Munro) Holtt. in Journ. Arn. Arb. 27: 341. 1946.

Basonym: *Gigantochloa heterostachya* Munro in Trans. Linn. Soc. 26: 125. 1868. Gamble in Ann. R. Bot. Gard. Calc. 7: 66, pl. 57. Ridley, Flora 5: 262.

Synonyms: *Gigantochloa latispiculata* Gamble, l.c. 67, pl. 59. Ridley, l.c. 263.

*Bambusa latispiculata* Holttum l.c. 341.

*Culms* commonly 6–10 m. tall (to 16 m. ?) and to 6 cm. diameter, not closely tufted, not branched at the lower nodes, medium green copiously and irregularly longitudinally streaked with paler green, edges of streak not sharply defined; walls of medium thickness. *Culm-sheaths* commonly 12 cm. long, black-hairy on the back; *blade* erect, on middle sheaths broadly triangular, commonly 7 cm. long and 5 cm. wide, apex stiff and narrowly acuminate, base slightly cordate, edges towards base bearing short bristles; *auricles* 10 mm. high, 2·5 cm. in lateral extent, edges slightly crisped, bearing many fine curved bristles to 15 mm. long; *ligule* 6 mm. tall (not including bristles) in the middle, edge incised so as to be bristly throughout, bristles 3 mm. or more long. *Leaf-blades* commonly 15–20 cm. long and 2–2·5 cm. wide (to 35 by 3·5 cm.), lower surface glabrous, stalk short; auricles small, glabrous; ligule 1–2 mm. high, edge sometimes bearing a few bristles. *Spikelets* few in each group (usually only one mature at a time), at maturity 4 cm. long, flat, 8–10 mm. wide, with quite smooth glumes and lemmas; *rachilla-internodes* 2 mm. long, flat; *lemmas* to 20 mm. long, stiffly pointed, to about 10 in number, the uppermost one or two containing imperfect flowers; *paleas* shorter than lemmas, 2 mm. wide between the fringed keels, about 7 veins between the keels with distinct cross-veins; *lodicules* 3, 3 mm. long, with a fringe of fine hairs over 1 mm. long; *filaments* of stamens joined to form a tube which appears to disintegrate on extension; *anthers* purple, 8 mm. long, with a few stiff hairs at the tip; *ovary* shortly ellipsoid, the hairy upper part narrowed to a hairy style which bears 1–3 finely hairy stigmas.

DISTRIBUTION: only known from villages in Singapore, Johore, Negri Sembilan, Malacca and probably Lower Perak.

RECORDED MALAY NAMES: Buloh Tilan (Tĕlang ?), B. Tilan Minyak, B. Pĕring, B. Pĕngahit (?).

The type specimens of *G. heterostachya* Munro were collected in Malacca by Griffith. The name given to this species referred to the fact that in addition to the fully developed broad flowering spikelets there were also slender spikelets which Munro stated to be sterile. I have dissected similar slender spikelets on other specimens and find them to be immature, not sterile, though it is possible that some sterile spikelets may be formed. I can see no other distinction between Griffith's type specimens at Kew and those upon which Gamble established a new species *G. latispiculata.* Several spikelets on Griffith's specimens are broad and flat with many lemmas; Gamble's figure is not representative of these large spikelets.

Munro and Gamble included this species in Gigantochloa, because of the stamen-tube. But the spikelet-structure, with its jointed rachilla and many equal lemmas, is Bambusa-like, and the stamen-tube is much more delicate when extended than that of Gigantochloa. Bambusa-like lodicules are also present. The culm-sheaths are very like those of *Bambusa vulgaris,* though smaller, but are easily distinguished by their ligule with its toothed or lacerate edge (as in *B. blumeana* and in some species of Gigantochloa). The streaky culms are straighter and closer than those of *B. vulgaris;* the streakiness is another Gigantochloa-like character.

It is possible that this bamboo is not uncommon in villages in the southern part of Malaya. I have certainly never seen it wild, nor have I seen it in villages in the north. Alvins stated that his original plant of *G. latispiculata* (collected 1886) was 50 feet tall and used for making baskets. I should judge that for this purpose this species would be similar in quality to the medium-sized Gigantochloas. Alvins gave the name Buloh Tilan Minyak; and the name B. Tilan was also given by a Malay Forest Guard who collected the species in Negri Sembilan fifty years later. Burkill (*Dictionary,* p. 1069) alters *tilan* to *tĕlang,* which means "marked with long streaky patches" (Wilkinson) and he may be right in so doing, as the meaning is appropriate; the form *tilan* may be local in Malacca and Negri Sembilan. Ridley had the species flowering in Singapore in 1896 (no. 8122); he reported the culms as 20–25 feet tall, "light green, white stripes", and gave the name *B. rumphii* var. *striata.* Another specimen collected in 1903 was labelled *B. vulgaris.* I found a flowering plant in Upper Serangoon in 1946, and plants without flowers on Pulau Samalun (S.W. Singapore) and near Kota Tinggi in Johore (plant brought to the University of Malaya for cultivation, not yet flowering). The specimen found by me near Telok Anson was in a patch of forest not far from open country; it was not well grown, the stems rather slender and the bristles on culm-sheath auricles very fine, but the ligule and the shape of the auricles point to this species. A Malay gave the name Buloh Pĕngait (from jahit, to sew) and said that strips of the culm were used to attach coconuts together, for transport (floating) by river. The same kind of strips could be used for basket-work.

*Specimens:* SINGAPORE, Cult. Hort. Bot. Ridley 6680 (S,K), 8122 (S), s.n. 28.9.1903 (K). Upper Serangoon Road, Holttum s.n. Sept. 1946 (S,Kep.), Ahmad bin Hassan s.n. 27.9.1946 (S). Pulau Samalun, Sinclair S.F.N. 38601 (S). MALACCA, Ayer Panas, Griffith 6731 (K, type). Bukit Bruang, Alvins s.n. 16.1.1886 (S, type of *G. latispiculata*). No locality, Cantley's Collector, 1717 (S). NEGRI SEMBILAN, Peradong, F.Gd. Hussein F.D. 9597 (S), 9598 (S,K). PERAK, Changkat Jong, near Telok Anson, Holttum S.F.N. 38432 (S).

6. **B. glaucescens** (Willd.) Sieb. ex Munro in Trans. Linn. Soc. 26: 89. 1868. Holtt. in Kew Bull. no. 2, 1956: 207–211.

Basonym: *Ludolfia glaucescens* Willd. in Ges. Naturf. Freunde Berl. Mag. 2: 320. 1808.

Synonyms: *Arundinaria glaucescens* Beauv., Essai Agrost. 144, 152. 1812. Ruprecht in Act. Acad. Caes. Petrop. Ser. VI Sci. nat. 5, pt. 2: 23, t. 1, f. 3. 1839.

*Bambusa nana* Roxb., Fl. Ind. 2nd Ed. 2: 199. 1832 (nom. subnud.). Munro l.c. 89. Ridl., Flora 5: 258.

*Bambusa multiplex* sensu Backer, Handb. Fl. Jav 2: 269 (not *Arundo multiplex* Lour. 1790).

*Culms* to about 5 m. tall and to 2 cm. diameter; longest internodes 30–50 cm. long, covered with white waxy powder when young, green and smooth when old; branches in rather dense short tufts from the nodes. *Culm-sheaths* (without the blade) commonly 12–15 cm. long, back smooth and hairless, green or light red-brown when young, soon turning light buff, apex rounded; *blade* always erect and pressed to the culm, narrowly triangular, acuminate, the base of the triangle extending to the full width of the rounded top of the sheath and there often slightly auricled with a few stiff bristles on the auricles, lower (outer) surface at first sparsely hairy, soon glabrous; *ligule* to 1·5 mm. tall, edge irregularly and shortly toothed (fig. 19). *Leaf-blades* about 5–12 cm. long and 6–15 mm. wide, base rather broadly cuneate above a short stalk, lower surface glaucous and covered with close very short velvety hairs; sheaths usually with a small fleshy crescent-shaped auricle on one or both sides, the auricles bearing stiff erect bristles when young; ligule low, minutely toothed. *Spikelet-groups* in Malayan plants usually on the ends of leafy branchlets, or sometimes on leafless branches; *spikelets* 3–4 cm. or more long when fully grown, with racilla-internodes to 5 mm. long; *lemmas* 10–16 mm. long, not apiculate, glabrous, the veins slightly raised; *paleas* a little shorter than lemmas, keels very shortly fringed (usually near apex only), veins between keels 7–8; *lodicules* 3–4 mm. long, narrowed to the apex, not fringed; *anthers* 6 mm. long, without apical hairs; *stigmas* 3, arising directly from the swollen hairy apex of the ovary.

DISTRIBUTION: native in China and Japan; commonly planted for hedges in Malaya and occasionally flowering if allowed to grow unchecked by clipping.

RECORDED MALAY NAMES: Buloh Pagar, Buloh China.

This species makes excellent hedges if well tended; but in the neighbourhood of secondary forest, tree-seeds, brought especially by birds, often grow in the hedge, and the trees can smother the bamboo entirely if not watched and pulled out from time to time.

The name *B. multiplex*, used by Backer, is based on *Arundo multiplex* Loureiro, a species which lacks a type specimen and was only identified by Merrill with *B. nana* Roxb. on the evidence of its vernacular name and its use for hedges (see Merrill's *Commentary* on Loureiro, p. 83). Merrill states that specimens of *B. nana* agree with Loureiro's description; but Loureiro described the leaves of his species as "6 poll . longa . . glabra . . . coloris fusco-viridis", none of which statements agree with *B.*

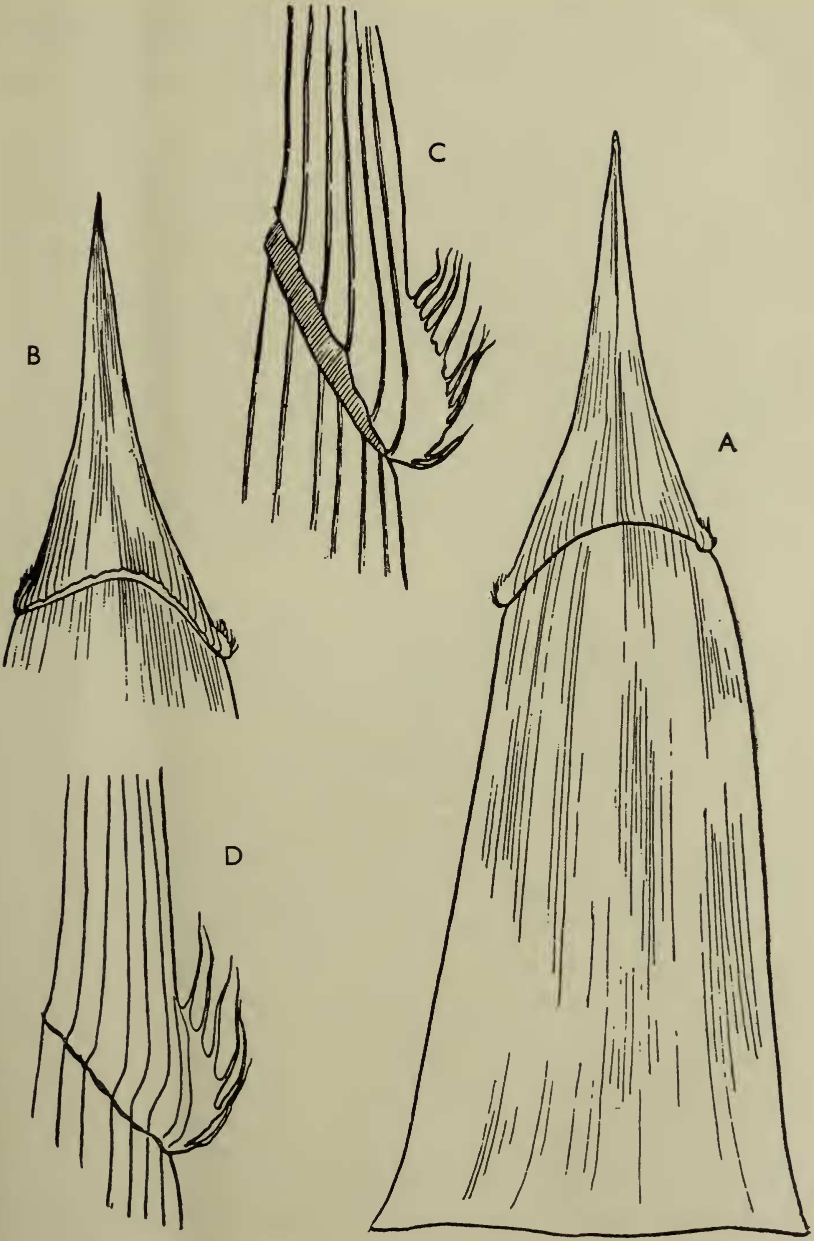

Fig. 19. Culm-sheath of *Bambusa glaucescens*. A, complete sheath, flattened, outer surface, × 1. B, inner surface of blade and top of sheath. C, inner surface of part of top of sheath, showing ligule (shaded), auricle and part of base of blade, × 4. D, outer surface of same parts shown in C.

*glaucescens* (*B. nana*). The distinguishing features of *B. glaucescens* are the softly hairy, pale glaucous, lower surfaces of the small leaves, and the culm-sheaths as above described (not mentioned by Loureiro).

*B. glaucescens* was introduced into cultivation in greenhouses in Europe before 1800, and named from a plant which flowered at Berlin in 1808; there is plenty of evidence that it was well known by this name in the early years of the 19th century. Similarly it was well known in India by Roxburgh's name *B. nana* from about the same time, having been introduced to Calcutta from China in 1794 (Roxb., Hort. Beng.). But Roxburgh published no description (only the statement that it was a shrubby thornless bamboo used for hedges), and the first description under the name *B. nana* is that of Munro (1868). For a full discussion, see Holttum in Kew Bulletin no. 2, 1956.

Gamble identified Wray's original specimen of *B. magica* as *B. nana,* for which reason he thought this species to be native in Malaya, but it is certainly introduced.

*Specimens:* SINGAPORE, Holland Road, Ridley s.n. 1898 (S). NEGRI SEMBILAN, Seremban, Alvins 1983 (S). PERAK, Taiping, Mahmood F.D. 9989 (S). PENANG, Government Hill, Ridley s.n. Feb. 1892 (S); Nauen S.F.N. 38097 (S). Between Ayer Itam & Penara Bukit, Burkill S.F.N. 1465 (S,K). No locality, Curtis 1720 (S,K).

7. **B. ventricosa** McClure in Lingnan Sci. Journ. 17: 57. 1938.

*Culm-internodes* of dwarfed pot-grown plants swollen, nearly as wide as long, to about 2·5 cm. diameter; internodes of well-grown plants in open ground much longer and of even thickness, to 4 cm. diameter, the culms to 8 m. long, successive internodes forming a slightly zig-zag pattern; long slender horizontal branches frequent from lower nodes of such culms. *Culm-sheaths* somewhat flushed with purple when young, quite hairless on the back, on the largest culms to 20 cm. long, top rounded, with a crisped auricle to 4 mm. high on each side of the base of the blade, edge of auricle bearing crisped bristles 4–5 mm. long; *blade* erect, smooth on the back and rough-hairy on the upper surface, on upper sheaths narrowly triangular with a slightly narrowed base and edges stiffly inflexed towards the pointed apex, edges bristly near the base, line of junction between sheath and blade not distinct externally in the middle part; *ligule* to 5 mm. high, lower towards its outer ends, edge sinuous and minutely hairy. *Leaf-blades* commonly to 15 by 2 cm., lower ones with broad truncate base, stalks short, lower surface very shortly soft-hairy (velvety to the touch), colour as upper surface; sheath-auricles usually with fine bristles when young; ligule short.

> DISTRIBUTION: probably native in China; sometimes cultivated as a pot plant in Malaya, and in the open ground at the Botanic Gardens, Singapore.

I obtained a potted plant of this species in 1936; the culms were not much more than 100 cm. tall, and the internodes much swollen, as above described. This plant was planted out in open ground in the Botanic Gardens, Singapore, and in about three years grew to quite a large clump, with tall culms having internodes of the cylindrical form usual in bamboos. Occasional more or less dwarfed culms were produced among the tall ones. The characters of the dwarfed and normal plant, and of culm-sheaths and leaves, agree closely with McClure's description, except that the Singapore plant in the open ground grew to a much larger size than reported by McClure in Canton. As noted by McClure, this species is certainly a near ally of *B. glaucescens*, and it would make an excellent tall hedge, either trimmed or allowed to grow naturally.

8. **Bambusa sp.**

*Culms* slender, forming a close compact clump, to about 250 cm. tall. *Culm-sheaths* black-hairy on the back, with small bristly auricles on each side of the blade; *blade* triangular, erect when young and somewhat spreading when old; *ligule* 2 mm. high with irregularly waved and minutely hairy edge. *Leaves* commonly to 12 cm. long and 1 cm. wide, with several longitudinal white stripes of unequal width, both surfaces glabrous.

Cultivated occasionally in Singapore (first seen by me near Upper Serangoon Road). I have not been able to identify this species, but it appears to be a Bambusa related to *B. glaucescens*, probably of Chinese origin.

9. **B. ridleyi** Gamble in Ann. R. Bot. Gard. Calc. 7: 34, pl. 32. 1896. Ridley, Flora 5: 257, fig. 225.

*Culms* slender, to 5 m. tall, little branched; internodes to 45 cm. long (Ridley), when young bearing spreading hairs 0·5 mm. long. *Culm-sheaths* about 9 cm. long, hairs pale, sparse; *blade* erect, 5–7 cm. long, 2 cm. wide, base cordate, apex acuminate; *auricles* spreading, ear-shaped, to 10 mm. long, bearing many slender bristles 10 mm. or more long; *ligule* low, entire (fig. 20A). *Leaf-blades* 20–30 cm. long and 2·5–5 cm. wide, base rather narrowly cuneate with stalk 2–3 mm. long, surfaces glabrous; auricles large, erect, thin, 4–10 mm. tall, with marginal bristles to 20 mm. long (fig. 20B), the two auricles connected across the front of the blade by the short stiff entire ligule (sometimes only one auricle developed). *Spikelets* on slender branches which may be leafy at the base, at nodes 1–15 cm. apart, few spikelets at each node; spikelets 4–5 cm. long, with 3–5 perfect florets and 1 or 2 imperfect ones; rachilla-internodes to 7 mm. long; *lemmas* 18–22 mm. long, glabrous, many-veined; *paleas* shorter than lemmas, keels slightly fringed near apex only, prolonged at apex into two short points, veins between keels 10 or more; *lodicules* 3, two 8–9 mm. long, asymmetric, fringed, the lower

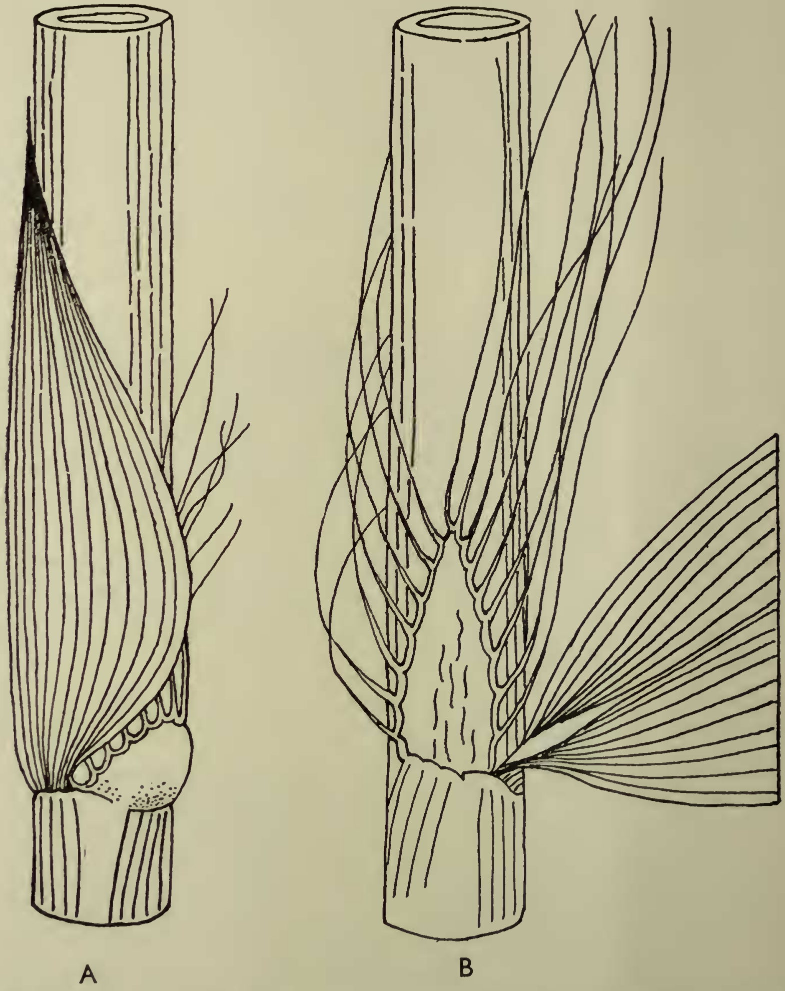

Fig. 20. *Bambusa ridleyi.* A, top of culm-sheath, with blade and auricle in natural position, on a slender culm, × 5/3. B, base of a leaf-blade and its auricle, enlarged.

1/3 very much swollen, the third lodicule shorter, sometimes only 3 mm. long; *anthers* 8 mm. long, apiculate; *ovary* 2 mm. long, style 4 mm.; stigmas 3, 10 mm. long (fig. 8, 9).

DISTRIBUTION: Singapore, Pahang.

RECORDED MALAY NAME: Buloh Akar (for the Pahang plant).

This small bamboo is distinct in its large leaf-auricles, long lemmas and 2-pointed paleas. It was first discovered by Ridley in the Bukit Timah forest, Singapore, where at least one plant persists. Ridley brought a plant to the Botanic Gardens, where it flowered in 1933, but later I could not find it. The only specimen from outside Singapore was collected by Symington in Pahang. This was sterile, and Symington records it as a "climbing bamboo, rampant over a small area", which would not agree with the plants I have seen in Singapore, so that the Pahang plant may represent another species, though I have never seen any other bamboo with such leaf-auricles. Or it may be that the plants I have seen in Singapore, in the shade of forest, are suppressed from vigorous growth by lack of light.

*Specimens:* SINGAPORE, Bukit Timah, Ridley 1693 (S); s.n. 12.8.1889 (S); s.n. 1902 (S,K); s.n. 1903 (S); s.n. 1911 (K). Botanic Gardens, Pestana S.F.N. 28316 (S,K). PAHANG, Kemasul Forest Reserve, Symington F.D. 49810 (Kep.).

10. **B. wrayi** Stapf in Kew Bull. 1893: 14. Gamble in Ann. R. Bot. Gard. Calc. 7: 49, pl. 46. Ridley, Flora 5: 259.

*Culms* 12–18 m. tall, about 2·5 cm. diameter (Wray), the top drooping almost to the ground; internodes yellow, shining, longest sometimes 200 cm. long. *Culm-sheaths* not known. *Leaf-blades* smooth, 15–25 cm. long, 2–3 cm. wide, base rounded above a short stalk; auricles small; auricles and ligule when young bearing erect bristles to 12 mm. long, those of ligule longest. *Spikelet-groups* at the nodes on the ends of short or long leafy branches; *pseudo-spikelets* consisting of 3 or 4 basal glume-like bracts of increasing size (with axillary buds) separated by internodes of 1 mm., one empty glume 10 mm. long separated from the perfect floret by a very short internode (the rachilla articulated below the glume and below the lemma), one perfect floret, and one small imperfect floret borne on a rachilla-internode 6 mm. long: *lemma* of perfect floret glabrous, 10–11 mm. long, with about 9 veins; *palea* slightly shorter, or as long as lemma, 2-keeled, with 2 veins between the keels and 3 veins between each keel and edge, keels bearing a few short hairs; *lodicules* 3·5 mm. long, narrowly elliptic, very shortly fringed; *anthers* at least 4 mm. long (immature), not apiculate; *ovary* narrowed gradually at the apex, which bears 3 long slender plumed stigmas; *imperfect floret* consisting of a lemma enclosing a small palea only.

DISTRIBUTION: only known from a restricted area on the Main Range near the sources of the Selama and Plus rivers, at 4,500–6,000 ft. altitude.

RECORDED MALAY NAME: Buloh Bersumpitan (Blowpipe bamboo).

Wray saw blow-pipes made from single internodes of this bamboo seven feet long, and described their construction in *Perak Museum Notes* 1, no. 3, p. 54 (1894). When he visited Gunong Inas he saw living plants in flower, and sent specimens to Kew (no. 4166), which were described by Stapf. The only other known specimens of this species were found by R. H. Yapp, also on G. Inas (s.n., 20. 12. 1899, at Kew). Wray noted however that the use of this bamboo for blowpipies is confined to the mountainous region near G. Inas; elsewhere, and in the lowlands, another bamboo was used, a species not then named, having internodes to about four feet long. The only such bamboo known to me is *Schizostachyum jaculans,* which see for further details.

Stapf discussed the peculiar structure of the spikelets in this species, comparing it with Nastus, in which genus also a spikelet contains only one perfect flower and one imperfect. But in Nastus the several glumes, of increasing size, are all empty (without axillary buds) whereas in *B. wrayi* they have axillary buds, except the highest, which I have found empty in all spikelets examined by me, though this is not mentioned by Stapf. Along with this difference is another, which Stapf did not mention. In Nastus the spikelet is a separate entity, its short stalk in the axil of a tiny bract very different from the glumes; in Bambusa (including *B. wrayi*) there is no sharp difference between the lower bracts on the spikelet-axis and the bract in the axil of which that axis arises. I suggest that the whole inflorescence-pattern in Nastus is more specialized than in Bambusa; it is very much like the pattern found in Arundinaria. The ovary in Nastus is quite similar to that in Bambusa, for which reason I believe the genera are related. (A paper on the genus Nastus, in which the subject is discussed more fully, is published in the *Kew Bulletin* no. 4, 1955, p. 591).

*Bambusa wrayi* is one of a group of species in Malaya and neighbouring countries, all characterized by a reduced number of florets in the spikelet. These species are not necessarily closely related; they may have arisen by an evolutionary process from different species of Bambusa with many florets. The species in question are: *B. pauciflora, B. klossii* and *B. montana* in Malaya; *B. griffithiana* Munro in Burma and *B. cornuta* Munro in Java (see Backer, Handb. Fl. Jav. 2: 265). The three Malayan species just mentioned are certainly closely allied, but they do not seem very close to *B. wrayi;* though they are slender climbing species, they do not have very long internodes.

11. **B. magica** Ridl. in Journ. Str. Br. R. As. Soc. 44: 208. 1904. Flora 5: 258.

Synonym: *B. elegans* Ridl., l.c. p. 209. Flora 5: 258.

*Culms* slender, to 5 m. tall; internodes to more than 60 cm. long; branches at nodes very densely clustered, slender. *Culm-sheaths* to 25 cm. long, the back rather sparsely covered with coarse brown hairs, narrowed to a rounded apex; *blade* at first erect, then quite deflexed, to 10 cm. long (or more on higher sheaths) and about 3 mm. wide, base abruptly widened to a narrow margin along the top of the sheath, ending in a small bristly auricle on each side (bristles often broken off); *ligule* 1–2 mm. high, with a fringe of stiff pale bristles up to 6 mm. long. *Leaf-blades* 8–16 cm. long, 8–15 mm. wide, thin, glabrous, glaucous beneath, stalk very short; auricles small and sometimes bristly; ends of ligule sometimes bearing small bristles. *Spikelet-groups* usually at nodes on the ends of leafy branches, the nodes about 1 cm. apart, the primary pseudo-spikelet at each node in the axil of a deciduous sheath 2–3 cm. long. *Pseudo-spikelets* 2–2·5 cm. long, secondary spikelets in the axils of the basal 1–2 bracts of the primary ones; following these bracts is usually one empty glume and about 4 perfect florets with a terminal imperfect one; *rachilla-internodes* flat, to 5 mm. long, with very short hairs on their edges; *lemmas* 10–15 mm. long, apiculate, edges shortly hairy; *paleas* shorter than lemmas, keeled towards apex, keels shortly fringed; *lodicules* 4–5 mm. long, acuminate, slightly hairy; *anthers* 4–5 mm. long.

DISTRIBUTION: a common bamboo on the higher and more exposed ridges of the Main Range, not known outside Malaya.

RECORDED MALAY NAME: Buloh Pĕrindu.

Ridley described *B. magica* and *B. elegans* in the same publication; the type specimen of the former was from Gunong Berumban, of the latter from Ulu Semangkok (near The Gap). The specimen named *B. elegans* was imperfect, and Ridley did not realize its identity with the other. The species is very abundant on the higher ridges around both Fraser's Hill and Cameron Highlands, and I think there is only one such species. The above description is made from my own collections from Cameron Highlands, and differs in various respects from Ridley's; but I believe it agrees with Ridley's specimens. The habit of the plants is not unlike that of *B. glaucescens,* but the culm-sheath blades are very different, the leaves are glabrous, and the spikelets much shorter. Gamble identified Wray's original specimen of *B. magica* with *B. glaucescens* (see *B. nana* in Gamble's Monograph).

Wray stated that this species is the Buloh Pĕrindu (yearning bamboo) of Malays, "credited with mystic properties, and much in request by love-lorn swains whose mistresses are cold and unresponsive" (*Journ. Str. Br. R. As. Soc.* 21: 159. 1890). But, as Burkill points out (*Dictionary,* p. 299) this name and magic properties may also be ascribed to other bamboos.

*Specimens:* PAHANG, G. Berumban, Wray 1560 (K,S,type); Ridley 13853 (S,K); Holttum S.F.N. 23403 (S,K). Cameron Highlands: Boundary Path, 5,000 ft., Holttum S.F.N. 31390 (S,Kep.); G. Brinchang 5,500–6,000 ft., Holttum s.n. 4.8.1946 (S); Rhododendron Hill, 5,100 ft., Henderson S.F.N. 17887 (S); Ulu Terla, Ja'amat F.D. 27612 (S,Kep.); Ulu Telom, Dolman F.D. 27251; no locality, Symington F.D. 20992 (S,Kep.), Ja'amat F.D. 27030 (S,K,Kep.). SELANGOR, Ulu Semangkok, Ridley 12114 (S,K, type of *B. elegans*); top of hill, Burn-Murdoch 11926 (S,K).

12. **B. pauciflora** Ridl., Flora Malay Penin. 5: 259. 1925.

*Culms* slender, supported on trees or trailing and branching on the ground in the forest, slender, diameter commonly under 2 cm., walls 3–4 mm. thick; internodes to c. 30 cm. long, a length of 1–1·5 cm. just below each node densely covered with shining white fine appressed hairs. *Culm-sheaths* c. 15 cm. long, pinkish or pinkish-brown when young, hairs on back sparse, pale brown, fine and closely appressed, shining; *blade* reflexed, green and leaf-like, one seen 8 cm. long and 1·8 cm. wide, narrowed abruptly at base (blades of lowest sheaths probably shorter and not green); auricles very low, extending laterally 7 mm. and slightly up-curved at the outer ends, firm, with a few bristles near the outer ends only; *ligule* consisting of an entire part hardly 1 mm. high, bearing a fringe of stiff bristles 10 mm. long. *Leaf-blades* to 20 by 2·8 cm., stalk short, lower surface bearing scattered hairs or nearly glabrous; auricles small, sometimes with a few bristles; ligule short. *Spikelets* borne in small groups on pendulous very slender branches, the groups 5–50 mm. apart;spikelets 10–12 mm. long, narrowly ellipsoid; basal bracts and glumes 3 or 4, of increasing size; *florets* 3 (always?), 2 perfect and 1 imperfect; *rachilla-internodes* 2 mm. long; *lemmas* 8 mm. long, smooth and glabrous, broad, many-veined, very shortly apiculate; *palea* as long as lemma but much narrower, 2-keeled from base to apex, keels not fringed, veins between keels 3, and 3 between each keel and edge; *lodicules* 2 mm. long, blade almost circular on a narrowly oblong base, upper margin with fine spreading hairs to 1 mm. long; *anthers* 3·5 mm. long, not apiculate.

> DISTRIBUTION: only known from Fraser's Hill, on the quartzite ridge.
>
> RECORDED MALAY NAME: Buloh Padi (grass-like bamboo).

The original collection was made by Mohamed Nur (S.F.N. 11234), and no other flowering specimens have been found. The above description of the culms and culm-sheaths was made by me from specimens near the path to Pine-Tree Hill from Fraser's Hill in 1953; the densely felted pale shining hairs below each node of the culm and its branches are very distinctive and are well shown by the type collection, so that I feel certain the plants seen by me belong to this species. A herbarium specimen, without flowers, was made at the same locality by Wyatt-Smith (F.D. 76177, Kep.). The culm-sheath auricles are very Gigantochloa-like.

This species is closely related to *B. montana* and *B. klossii,* but has larger spikelets, a different culm-sheath ligule, and the very distinctive zone of hairs below each node. I do not doubt that it is a quite distinct species. So far as observed, it occurs only on the quartzite ridge at Fraser's Hill, on which also are some other peculiar plants not found on the granite (e.g. the ferns *Hypolepis bivalvis* and *Cyathea kingii,* and *Dacrydium falciforme*). It may occur on the higher ridges on the granite of the Main Range, where the soils are much leached and peat occurs, but I have not noticed it. It is perhaps significant that *B. klossii* occurs in the poor soil derived from sandstone on the upper part of Kedah Peak, and *B. montana* only very locally on the higher parts of Penang Hill, which is granite but yields a very sandy soil.

13. **B. montana** (Ridley) Holtt. in Kew Bull. no. 2, 1956: 206.

Basonym: *Dinochloa montana* Ridl. in Journ. Str. Br. R. As. Soc. 44: 210. 1905. Flora 5: 267.

A thicket-forming bamboo with long scrambling culms (Ridley); culm-sheaths not known. *Leaf-blades* to about 20 cm. long and 3 cm. wide, base slightly unequally cuneate above a stalk 3–5 mm. long, larger leaves glabrous beneath, auricles usually small and not bristly, ligule short; small leaves on flowering branches 5 by 1 cm. to 10 by 1·5 cm. may have rather copious fine hairs 0·5 mm. long on lower surface, and slender bristles to 7 mm. long on auricles (specimen in Herb. Kew.), but some such leaves have very few hairs and glabrous auricles (specimen in Herb. B.M.). *Flowering branches* slender, sometimes leafy at the base, bearing spikelets in dense groups at nodes 5 mm. to 5 cm. apart, the smaller internodes hairy along one side, hairs curved and reflexed, not closely appressed. *Spikelets* c. 9 mm. long, with 2 empty glumes above the basal bud-bearing bracts, axis jointed above the upper glume; *florets* 3, the first perfect, the second sometimes imperfect (?) and the third rudimentary, the rachilla jointed below each floret, rachilla-internode between first and second florets 2 mm. long (fig. 21); *lemma* of first floret 7 mm. long, shortly apiculate, glabrous, many-veined; *palea* minutely fringed on the keels; *lodicules* 3, unequal, largest 2·2 mm. long, bearing a close fringe of hairs 0·5 mm. long; *anthers* 6, purple, 4·3 mm. long, not apiculate; *ovary* and stigmas not seen; *fruit* "oblong, beaked, narrowed at base, beak hairy" (Ridley).

Distribution: only known from Penang Hill, from three collections made by Ridley and Curtis (apparently all from the same plant) in December 1895, April 1896 and March 1899, nos. 7064, 7265, 10171.

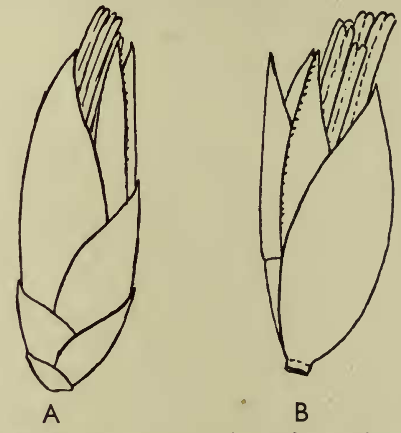

Fig. 21. *Bambusa montana.* A, outer view of complete spikelet, × 5; stamens are protruding from lower floret. B, same with bracts and glumes removed; upper floret seen attached to rachilla on left (this floret is still immature and its lemma enfolds a third rudimentary floret).

The above description is prepared from the sheets of no. 10171 at Singapore, Kew and the British Museum, the only sheet having mature spikelets being that at the British Museum. Ridley reported that he saw fruits, and six lodicules, but no fruits remain on any of the specimens. The six lodicules were doubtless from the two florets, only one of which would produce a fruit. The second floret in the spikelets I dissected at the British Museum was immature.

The first specimen collected by Ridley and Curtis (7064) had no flowers; the second (7265) was flowering, but no mature spikelets remain on any specimen. Both these collections are represented only at Singapore; neither has leaves so hairy as the Kew specimen of 10171, and neither has bristly leaf-auricles.

This species is certainly a Bambusa, not a Dinochloa. It is very near *B. klossii* and if the two are vegetatively similar they should probably be united; the differences in spikelet-structure are slight, and may disappear when more specimens of both are examined. Further search for *B. montana* on Penang Hill should be made.

14. **B. klossii** Ridl., Flora Malay Penin. 5: 259. 1925.

*Culms* 2·5 cm. diameter (to 4 cm. ?), walls 6 mm. thick, internodes to 40 cm. long; few white hairs near top of internode, and a little white waxy powder below the node. *Culm-sheaths* flushed purple when young, hairs on back nearly white, not very copious, with some waxy powder; *auricle* forming a low rim (5–6 mm. in lateral extent) to the top of the sheath on each side of the blade, this rim purple, barely 1 mm. high, usually bearing a few slender bristles 5–8 mm. long; *ligule* 2–3 mm. tall, firm, with an irregular edge which bears a few very slender bristles 5–9 mm. long (longest near ends of ligule). *Leaf-blades* 20–30 cm. long, 1·5–3·2 cm. wide, lower surface glabrous, stalks of lower leaves 3 mm. long; ligule short, sometimes with a few fine bristles, auricles usually not bristly. *Flowering branches* slender, sometimes laxly branched, sometimes unbranched at the ends of leafy branchlets, the ultimate flowering branchlets to 30 cm. or more long, bearing dense groups of spikelets at nodes 5 mm. to 5 cm. apart; distal internodes hairy along one side. *Spikelets* 7–8 mm. long; perfect florets 1 or 2, in the latter case separated by a rachilla-internode 1–2 mm. long, with a rudimentary terminal floret jointed to a similar rachilla-internode; *lemma* of perfect floret 6–7 mm. long, shortly apiculate, glabrous; *palea* keeled, keels fringed, 2 veins between the keels and 2 between each keel and edge; *lodicules* 3, obovate, unequal, largest 2–2·5 mm. long, long-fringed; *anthers* 4 mm. long, purple, not apiculate; *ovary* glabrous, with 3 hairy stigmas gradually diverging from a short hairy style.

DISTRIBUTION: Kedah Peak, at about 3,000 ft. altitude.

The only two collections were made by Robinson and Kloss (6069, 6109), both represented only at Kew (no. 6069 is the type; Ridley labelled the other, with a query, *Oxytenanthera sinuata*). I have dissected spikelets of both, and see no essential difference.

The above description of culms and culm-sheaths was made by me from living plants when I visited Kedah Peak in January 1954 (specimen K. 16, S.). The plants were not flowering, but they were abundant at about 3,000 ft. and I saw no other bamboos at that elevation. The culm-sheaths are much like those of *B. pauciflora.*

The spikelets of *B. klossii* (I have only dissected one from each specimen) differ little from those of *B. montana,* and it is possible that the two species should be united under the name *B. montana,* which is the earlier.

## THYRSOSTACHYS

**Thyrsostachys** Gamble in Indian Forester 20: 1. 1894.

Type species: *T. oliveri* Gamble, l.c. Bor in Indian For. Rec. N.S. Bot. 2: 222. 1941.

*Spikelets* consisting of 2 or 3 perfect florets and an extension of the rachilla bearing a minute rudimentary floret; *palea* of lower florets deeply 2-cleft, with narrow tail-like divisions, 2-keeled, ciliate on the keels, palea of uppermost floret not sharply keeled and only a little cleft; *lodicules* 0, 2 or 3, narow; *stamens* 6, filaments free, anthers with a short tip; *ovary* small, cylindrical, its fleshy apex swollen, glabrous or nearly so, bearing a long tapering glabrous style; stigmas 3, hairy; *fruit* cylindric, glabrous, beaked.

This is a genus of two known species, from Burma and Siam. These species are certainly very close to Bambusa, and have the same type of ovary (except that the swollen top is almost or quite glabrous); they agree with certain species of Bambusa in having only 2 or 3 perfect florets, but differ in the deeply cleft paleas, and also apparently in the extremely reduced nature of the terminal floret. Only one species is known in Malaya; it is not native, but is common in gardens.

**T. siamensis** Gamble in Ann. R. Bot. Gard. Calc. 7: 59, pl. 51. 1896.

*Culms* commonly 8–10 m. tall, densely tufted, basal part not or little branched, 4–5 cm. diameter near the base, very thick-walled; longest internodes about 30 cm. long, green. *Culm-sheaths* to 20 cm. long, pale, thin, persistent, back covered with inconspicuous short pale appressed hairs, edges fringed towards apex when young, line of junction with blade distinct, raised slightly in the middle where blade is attached, upcurved again a little on each side of base of blade; *auricles* very small; *blade* erect, narrowly triangular, edges incurved, base slightly narrowed; *ligule* low, slightly and irregularly toothed, glabrous. *Leaf-blades* commonly to about 12 cm. long and 8 mm. wide, glabrous or sometimes sparsely hairy, lower surface of same colour as upper, short-stalked; auricles very small, sometimes with a few short thin bristles; ligule short, entire. *Spikelets* in small groups in the axils of persistent short sheaths on slender branchlets, or in larger groups on larger branches, each spikelet about 17 mm. long, the bracts and glumes finely hairy; perfect florets usually 2; internode between florets short; rachilla-extension at top of spikelet 6 mm. long, thickened at the tip (rudimentary floret not distinctly developed); *palea* of lower floret cleft half way or more towards the base; top of *ovary* and style apparently quite glabrous, base of style thick and persistent as a beak on the fruit; lodicules 1·5 mm. long, narrow.

DISTRIBUTION: Burma and Siam; often cultivated in Malaya as an ornamental plant.

This is a very graceful bamboo, owing to its compact clumps of out-curving slender culms, bearing many small leaves on slender branches. It very rarely flowers in Malaya. There are some very poor specimens of a clump that flowered in Singapore after transplanting about 1915; the flowers are not clearly distinguishable. Some plants transplanted to fill gaps in a hedge in Dalvey Road, Singapore, flowered well in 1949 (Holttum, S.F.N. 37943); and several old undisturbed clumps flowered simultaneously in Penang in 1948 (Holttum, S.F.N. 38450).

It may be that the first name published for this species was *Bambusa regia* Thomson (ex Munro in *Trans. Linn. Soc.* 26: 116. 1868); but the description was from sterile specimens and no good description of culm-sheaths was included, so that it is open to doubt.

## DINOCHLOA

**Dinochloa** Buse in Miquel, Plant. Junghuhn. 388. 1854.

Type species: *Nastus* (?) *tjankorreh* Schult., Syst. Veg. 7: 1358. 1830, from Java.

*Climbing bamboos,* with zig-zag culms; *culm-sheaths* thick, when dry wrinkled at the base where a leathery ring of uneven width remains after the sheath falls; *leaves* with distinct transverse veins (seen in dried specimens on lower surface). *Spikelets* very short, borne in groups at the nodes of slender leafless branched stems, one-flowered, rachilla not produced beyond the flower; *glumes* (lacking axillary buds) 1 or 2, ventricose with a distinct stiff tip; *lemma* similar, commonly about 4 mm. long; *palea* broad and convolute, usually longer than the lemma and thinner in texture, not keeled but very slightly 2-pointed, the two points touching; *lodicules* absent (present in Philippine species); *stamens* 6, free, short; *ovary* ovoid, glabrous, its widened apex gradually attenuate upwards (style-like) and bearing 3 long slightly plumose stigmas; *fruit* ovoid, shortly beaked, or spherical, longer than lemma and palea; pericarp thin except at top of fruit, smooth and dry when ripe, or fleshy and of even thickness throughout; seed consisting mainly of endosperm, with embryo about 1/3 of its length, in dry fruits (lacking endosperm in fleshy fruits ?).

A genus of few species, at low elevations in forest in Burma, Indochina, Hainan, the Andamans and Nicobars, Western Malaysia and the Philippines; in Malaya apparently represented by two species which are not abundant and rarely flower. Ridley's *D. montana,* from Penang Hill, is a species of Bambusa.

The spikelets are not only reduced to a single floret; the lemma, palea and floral parts are much shorter than in other bamboos. As in other such cases in many plant families, the result of this reduction is that characters which might indicate relationships to other genera are so modified as to be difficult to interpret. The traditional position of this genus is near Schizostachyum and Melocanna, where it was placed by Munro, mainly on the evidence of the fruit (which he never saw, relying on the description of Schultes). The question of the fruit will be considered later; the subjects of spikelet-morphology and ovary-structure need first to be considered.

Bentham (*Genera Plantarum* 3: 1214) said he could see no palea in Dinochloa. He was looking for a two-keeled structure, which is certainly not to be found. But Munro and Gamble both interpreted the Dinochloa spikelet as having one perfect floret enclosed by lemma and palea, and that interpretation is here accepted. Presumably Bentham thought the organ here regarded as the lemma of the perfect floret to be the lemma of a missing floret, the organ here regarded as the palea to be a lemma enclosing floral parts, the true lemma being lacking. A similar interpretation has been given in the case of Oryza (rice) but in the case of no other genus in the sub-family Pooideæ, and the case of Oryza is doubtful.

In the genus Chloothamnus there is only one perfect floret and no extension of the rachilla beyond it; the palea is quite unkeeled, but has a slight thickening of two veins just at the tip, giving a broad and very slightly two-pointed apex. Exactly this condition occurs also in Dinochloa. In Bambusa (to which, on ovary-form, I believe Chloothamnus to be related) there is always a more or less reduced terminal floret on a rather thick rachilla-extension, and the palea of the uppermost perfect floret is always strongly keeled throughout. The two keels converge and almost meet at the apex of the palea, which is thus formed by the thickened tips of the two keels almost touching. If one could smooth out the rest of the keels and leave the tips only, one would have the condition of Chloothamnus; and I believe that Dinochloa shows the same characters, though in a reduced condition.

Dinochloa has traditionally been placed near Schizostachyum, but the palea in that genus is distinctly different (again, Bentham doubted if it was really a palea, presumably because it is not two-keeled throughout). In Schizostachyum the sole or uppermost perfect floret has a palea which is normally more or less grooved near the apex, rarely to the base, the edges of the groove hardly forming keels; at the apex there are always two distinct terete (almost spine-like) tips which represent the ends of the keels. These two tips are usually separate (sometimes almost contiguous) and do not converge as in Bambusa. Thus the evidence of the palea would place Dinochloa near Bambusa rather than near Schizostachyum.

The ovary in Dinochloa has a fleshy apex which is gradually attenuate upwards (thus forming what is called a short style) with three stigmas at its apex; this is very much like the condition of some Bambusa species except that the top of the ovary in Dinochloa is not hairy. I regard the evidence of the ovary therefore as pointing to affinity with Bambusa.

The fruit in *Dinochloa scandens,* as described from Java specimens by Backer (the type was from Java, and Backer only reckons one species in that island) is longer than the lemma and palea (this is not surprising, in view of their small size), shining brown, the embryo 1/2–1/3 as long as the fruit. Apparently the sides of the pericarp are thin enough to show the position of the embryo in an entire dry fruit. A single fruit of *D. scandens* var. *andamanica* (Kurz) from Gamble's herbarium agrees with this description. The sides of the pericarp are quite thin, smooth and shining externally; the seed consists mainly of endosperm, the embryo being proportionately larger than in most bamboo seeds but not otherwise abnormal.

The fruit in a Dinochloa from Borneo and the Philippines, named *D. scandens* by Gamble, is quite different. It is larger, and quite spherical, with a fleshy pericarp of even thickness throughout. The surface of the pericarp of a dried fruit is wrinkled, not smooth. The spikelets bearing such fruits are not different in essentials from those of *D. scandens* var. *andamanica.* It thus appears that two types of fruit occur in one genus. But the species bearing fleshy fruits cannot be *D. scandens;* it needs a new name, and a new description made from living plants.

I conclude therefore that the genus Dinochloa is probably related to Bambusa; and it is perhaps significant that the mountain species of Bambusa in Malaya which have a reduced number of florets in the spikelet also have slender more or less climbing stems tending towards the condition of Dinochloa.

The rather distinct cross-veins in the leaves do not suggest a near relationship to Bambusa, but this character in bamboos is difficult to describe clearly from external features (it should be described from anatomical features) nor is its value clear in assessing relationships.

McClure, in *Kew Bulletin* 1936, p. 253, included *Melocalamus compactiflorus* in Dinochloa. In my opinion he was wrong in so doing, and I can only conclude that he did not dissect spikelets of the type material, which clearly have two perfect florets (in some other specimens there are three) and a rachilla-extension with a rudiment at its tip, the paleas of all the perfect florets normally two-keeled, a condition quite incompatible with Dinochloa and with McClure's description, but agreeing with descriptions by Kurz and Gamble.

### Species in the Malay Peninsula

Leaves commonly to 20 cm. long and 3 cm. wide; leaf-auricles and ligules usually bearing bristles; smaller branches not very rough below the nodes .. .. .. 1. *D. scandens*

Leaves (at least on lower branches) to 5·5 cm. wide; leaf-auricles and ligules lacking bristles; smaller branches below the nodes very rough from the bases of fallen hairs (probably densely hairy when young) .. 2. *D. sp.*

1. **D. scandens** (Bl.) O. Ktze, Rev. Gen. Pl. 773. 1891. Backer, Handb. Fl. Jav. 2: 289.

Basonym: *Bambusa scandens* Bl. ex Nees in Flora 7: 291. 1824.

Synonyms: *Nastus ? tjankorreh* Schult., Syst. Veg. 7: 1358. 1830.

*Dinochloa tjankorreh* Buse in Miquel, Pl. Jungh. 388. 1854. Gamble in Ann. R. Bot. Gard. Calc. 7: 112, pl. 98. Ridl. Flora 5: 267.

*Culms climbing,* the lower part unbranched and 8–25 mm. diameter (Backer), with prominent nodes, internodes when young bearing scattered ascending appressed stiff pale hairs, the bases of which later leave scattered minute warts. Upper *culm-sheaths* (fide Backer, not seen in Malayan specimens) 9–12 cm. long, narrowed and gaping towards the apex, suffused with purple, hairs white to purplish; ligule 1–1·5 mm. high with shortly fringed edge; auricles apparently low and firm, as in *Bambusa pauciflora* (sometimes fringed with bristles?); blade at first erect, then spreading, ovate-lanceolate, 5–8 cm. long and 10–20 mm. wide, base rounded or slightly cordate. *Leaf-blades* on upper branches commonly to 20 cm. long and 3 cm. wide, base cuneate, stalk short; sheaths hairy when young, usually with a few bristles on the small auricles; ligule short, bearing a few bristles each side near the auricles. Larger spikelet-bearing branches somewhat rough (like the culms), smaller ones quite smooth; *pseudospikelets* to about 5 mm. long and 2·5 mm. wide, terete, acute; *lemma* very broad with a rounded top having a very short tip; *palea* longer than lemma, 4–4·5 mm. long, very broad, apparently glabrous (Backer says very shortly fringed), veins numerous, with cross-veins; filaments short, *anthers* 4 mm. long including a distinct slender tip bearing many short hairs; *ovary* short, narrowed to a (glabrous?) style 1 mm. long which bears 3 gradually diverging stigmas; fruit 7 mm. long (Backer).

Distribution: Western Malaysia (type from West Java) and also in the region immediately north of Malaya; in Malaya collected only once in flower, at Lumut in Perak (Ridley 3112; S,K). This flowering specimen has rather small groups of spikelets on very slender branches. The discrimination of species in this genus is difficult, and it is possible that the plants in Malaya differ from those in Java (from which part of the above description, as indicated, is derived), in which case it may be shown that they represent a distinct species. Further flowering material, and full notes on vegetative parts of plants in Malaya, are needed. The figures of lemma and palea given by Munro (Trans. Linn. Soc. 26: pl. 5, figs. 4, 5), showing fringes of stiff hairs, are like nothing I have seen.

### 2. **Dinochloa, sp. ined.**

Specimens of what appears to be a second (and probably undescribed) species of Dinochloa have been found at three localities in southern Malaya; their distinctive characters are shown in the key. The plant I saw on Gunong Panti had long unbranched stems trailing along the ground in the forest, bearing leaves; I could get no specimen of climbing stems, which would doubtless have leafy branches at the nodes, the branch-leaves smaller than those on the main stem which I collected. It looks as if other specimens are from similar material. The specimens are:

Johore, G. Panti, Holttum s.n. 8.9.1929 (S); Corner s.n. 13.10.1935 (S). G. Pulai, Ridley 12150 (S,K). Malacca, Bukit Lenggeh F.R., Dolman, F.D. 25254 (S).

## DENDROCALAMUS

**Dendrocalamus** Nees in Linnaea 9: 476. 1834.

Type species: *Bambusa stricta* Roxb., Corom. Pl. 1: 58. 1798.

*Culms* forming dense clumps, in the more slender species with drooping upper parts; in *D. strictus* with branches often from lower parts of culms, in other species not. *Culm-sheaths* usually with rather pale hairs (sometimes sparse), in several species mixed with white waxy powder; blade rigid, not green and leaf-like on middle sheaths. *Spikelets* in dense groups at the nodes of usually leafless branches; perfect florets 1–6, the apical floret sometimes sterile or reduced and then on an elongated extension of the rachilla (this character not constant even in one spikelet-group), rachilla-internodes between perfect florets very short and not articulated below the florets; *lemmas* broad, glabrous or finely hairy, not long-fringed on the edges, many-veined, progressively longer towards apex of spikelet; *paleas* of lower florets 2-keeled, thin and translucent, veins between keels few, keels usually fringed with hairs, sometimes hairs on back and edges also; palea of uppermost perfect floret (or of sole floret if only one) not or only slightly keeled, often glabrous; *stamens* 6, with free or more or less completely joined filaments (the extended tube, if present, very thin), anthers not or shortly pointed at the apex; *lodicules* rare (not known in Malayan species); *ovary* with hairy apex (except apparently in *D. elegans*) bearing a long slender hairy style with usually an undivided stigma; *fruit* (seen in *D. pendulus*) not longer than lemma and palea, pericarp thick at top of fruit and easily separable from seed, very thin towards base of fruit; embryo small and round, hilum linear, extending whole length of seed (for floral details, see figs. 23 and 26).

A fairly large genus, widely distributed in India (especially the north-east), Ceylon, Burma, Siam, Indochina and southern China, apparently not native in Java and doubtfully in Borneo, but reported in the Philippines and New Guinea; in Malaya represented by one very abundant species, two of less clear status, and two slender species on limestone in the north. In Malaya also one species is very commonly planted (*D. asper*) and two others (*D. strictus* and *D. giganteus*) less commonly; in the Botanic Gardens, Singapore, are also *D. hamiltoni* and *D. latiflorus,* which I have not included in the present treatment, as they are unlikely to be generally planted.

I would include in this genus most of the Indian species placed by Gamble (following Munro) in Oxytenanthera (the others are Gigantochloa). The type species of Oxytenanthera is *O. abyssinica* (Rich.) Munro. This has an ovary very different from that of the Asiatic species referred to the genus by Gamble, for which reason I consider that these Asiatic species should be in another genus. The only reason for separating them from Dendrocalamus is the stamen-tube; but, as stamen-tubes occur also in other very widely different genera of bamboos, I do not consider the presence of a stamen-tube alone a sufficient character for the delimitation of genera. In general spikelet-structure, and in the form of the ovary, these species do not differ from *Dendrocalamus strictus,* the type species of the genus. I have found it very difficult to see whether in fact a stamen-tube is present in our native Malayan species; the tube, if present, is much more delicate than that of Gigantochloa, in which genus it is invariably firm and very distinct, even when extended.

The type species, *D. strictus,* has two or three perfect florets; all the native Malayan species except *D. asper* (and this is doubtfully native) have one, two or three florets. There are two species, *D. asper* and *D. giganteus,* which have spikelets of a different aspect (with looser or hairy lemmas) and containing a larger number of florets; the culms also of these species are very large and more rigid than the others. If one had only the species here considered, there would be a good case for separating *D. asper* and *D. giganteus* in a distinct genus from the others. But, looking over the Indian species (including those now called Oxytenanthera) I do not see how to define two genera clearly. McClure has proposed a new genus, Sinocalamus, the type species of which, *Dendrocalamus latiflorus* Munro, is very like *D. asper* and would certainly be in the same genus as *D. asper* (though McClure later included *D. asper* in Gigantochloa). McClure states that his genus differs from Dendrocalamus in having lodicules; but in the type species there are none. The only possible distinctive character I can see in his diagnosis is the broad ventricose shape of the lemmas, and this is not a precisely definable character; I could not use it to my satisfaction as a means of sepatrating the species of Dendrocalamus (in the broad sense here used) into two parts.

**Field characters** (native species). The long slender shining dark green culms of *D. pendulus,* their upper parts curved downwards or resting on forest trees, bearing long slender leafy pendulous branches, are abundant and distinctive in the lower valleys of the Main Range as one travels along the roads to Ginting Simpah, The Gap, and Cameron Highlands. The white-waxy sheaths of erect unbranched young culms, with their rigid pinkish blades, are also distinctive. The hairs on the sheaths also are nearly white, but it may be (as certainly in *D. hirtellus*) that they are darker on lower sheaths. There is no question that *D. pendulus* is an abundant and distinct species, all along the Main Range. It is not a village bamboo.

In Johore and Kedah, and in various other parts of Malaya away from the Main Range, occur wild plants of Dendrocalamus which are closely related to *D. pendulus,* with very similar culm-sheaths and spikelets, but of more erect habit, with softly hairy, usually larger, leaves. I believe also that these other plants differ from *D. pendulus* in having a conspicuous white waxy powder on the young culms (as distinct from the sheaths) and in having darker (often fewer) hairs on the sheaths. In Kedah I found much variation in size of ligule and auricles on the culm-sheaths, and could not see any useful character in these organs by which to distinguish species. In fact, the only apparently clear characters by which one can separate these large-hairy-leaved native Dendrocalamus plants into two species are in the number of flowers in a spikelet and in some floral details; and these are not practicable field characters. There is need for further study of these plants.

In Kedah and Langkawi, especially on limestone hills, are slender short plants of Dendrocalamus which have been described as two species; but again, I am not sure how good are the apparent distinctions between them.

**Uses.** The principal useful species is *D. asper,* which is cultivated by Chinese market gardeners in most parts of Malaya for its excellent and large edible shoots. It can also be found in Malay villages, but I do not think it is systematically planted, and Malays also eat the shoots of other bamboos. The only other species I have found to be (occasionally) planted for this purpose in Singapore is *Gigantochloa levis,* which resembles *D. asper* in several ways and is said also to have shoots of excellent edible quality; for notes on the distinctions between this and *D. asper,* see the description of *G. levis.* The old culms of *D. asper* are large and strong, useful for building purposes, but probably not abundant enough to be much used, as only a limited number are allowed to grow on each plant.

I found that *D. pendulus* was used for basket-making near the Cameron Highlands road, but it was not the bamboo most used for that purpose. Its long culms of very even thickness (not too stout) look as if they would make useful poles, if fully mature and suitably treated, but probably they are not as strong as the culms of *D. strictus*.

*D. strictus*, an Indian species, is an important source of bamboo poles, and might profitably be more planted in Malaya for that purpose. At present, the only plants of it that I know are several large clumps in the Public Gardens at Kuala Lumpur, and a few in the Botanic Gardens, Singapore.

*D. giganteus*, probably the largest of all bamboos, was reported by Ridley as native in Malaya, but I have failed to trace the specimens he quotes and have seen no others. There is a large clump at the Forest Research Institute, Kepong, from which others could be propagated. The culms are probably too large for some purposes, but should be useful for building. Where the species is native, the lower internodes are used as buckets.

### Key based mainly on spikelet characters

- Spikelets all with one floret, or some with 2 florets, glabrous
  - Palea of single (or upper) floret with 4 veins; stamens 6
    - Anthers 4 mm. long; tall bamboos
      - Leaves hairless on lower surface, 2–3 cm. wide .. .. 1. *D. pendulus*
      - Leaves softly hairy on lower surface, 3–6 cm. wide .. .. 2. *D. hirtellus*
    - Anthers 2·5 mm. long; slender small bamboo .. .. .. 3. *D. elegans*
  - Palea of single floret with 7 veins; stamens variable, 3–6 (?) .. .. 4. *D. dumosus*
- Spikelets all with 2 or more florets; lemmas more or less hairy
  - Florets 2 or 3
    - Native species; filaments united to form a tube .. .. .. 5. *D. sinuatus*
    - Planted, introduced species, not common in Malaya; filaments free .. 6. *D. strictus*
  - Florets at least 4, usually 5 or 6
    - Spikelets 6–9 mm. long .. .. 7. *D. asper*
    - Spikelets 15–20 mm. long .. .. 8. *D. giganteus*

### Key based mainly on vegetative characters

- Very large culms, 18–25 cm. diameter; rarely planted, doubtfully native .. .. 8. *D. giganteus*
- Culms smaller
  - Culms commonly 12 cm. diameter, basal internodes densely brown-hairy .. 7. *D. asper*
  - Culms more slender, basal internodes not so hairy
    - Auricles of culm-sheaths not bristly; planted, not native .. .. 6. *D. strictus*
    - Auricles of culm-sheaths bristly; native bamboos, rarely planted
      - Sheaths or young culms (or both) copiously white-waxy; culms c. 6–9 cm. diameter
        - Very long slender forest bamboo, needing support of trees; young culms not conspicuously waxy; leaves glabrous .. .. 1. *D. pendulus*
        - Less long and more erect, in more open places; young culms white-waxy; leaves softly hairy beneath
          - Spikelets with 1 or 2 flowers; palea glabrous .. .. 2. *D. hirtellus*
          - Spikelets with 2 or 3 flowers; palea hairy .. .. 5. *D. sinuatus*
      - Sheaths and young culms not white-waxy; culms 2·5 cm. diameter
        - Leaves soft-hairy beneath .. 3. *D. elegans*
        - Leaves not hairy beneath .. 4. *D. dumosus*

1. **D. pendulus** Ridl. in Journ. Str. Br. R. As. Soc. 44: 210. 1905. Flora 5: 266.

Synonyms: *Schizostachyum subcordatum* Ridl. in J.S.B.R.A.S. 82: 204. 1920. Flora 5: 269.

*Cephalostachyum malayanum* Ridl. in J.S.B.R.A.S. 57: 118. 1910. Flora 5: 267.

*Culms* to at least 30 m. long, to about 9 cm. diameter near base, when old smooth and dark green, nodes somewhat prominent, the lower ones with many roots; branches long, slender, pendulous.

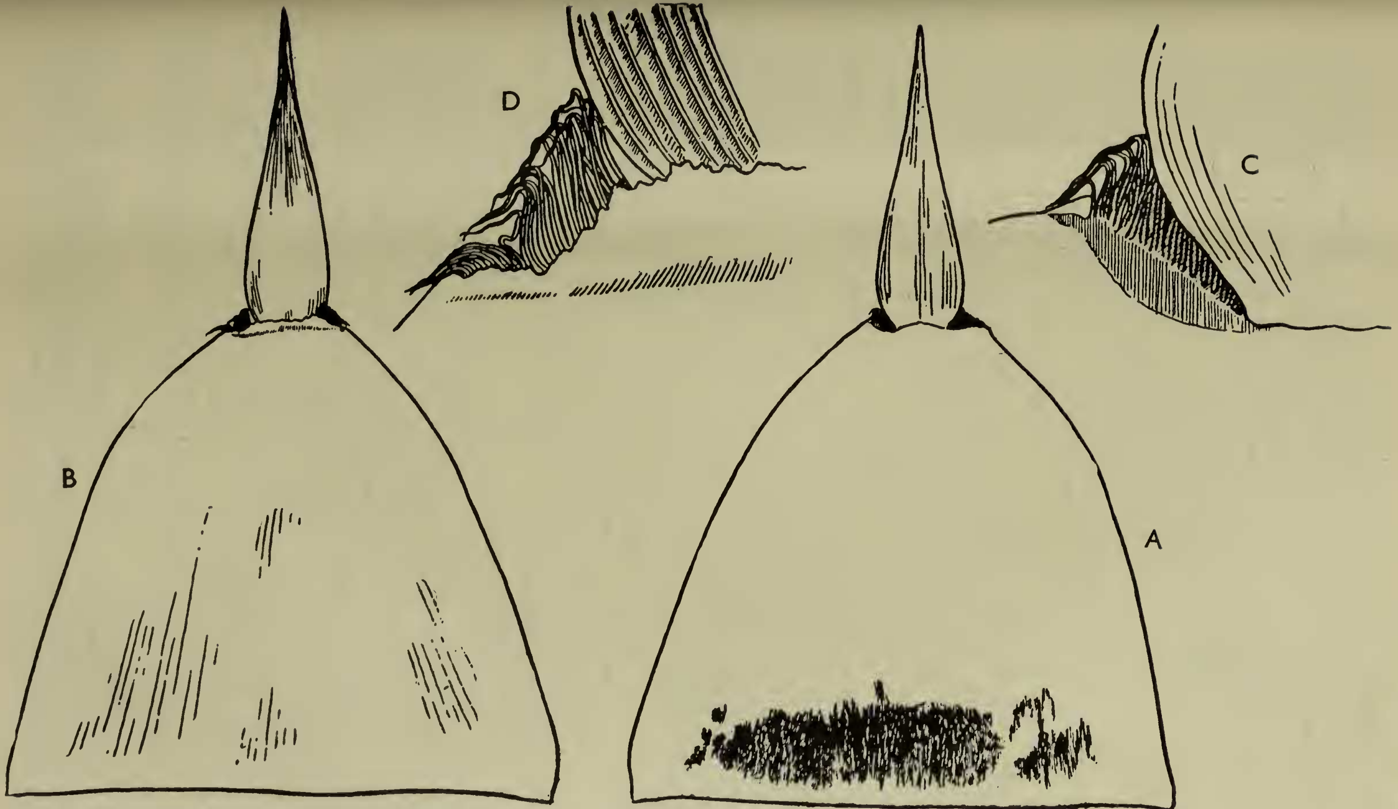

Fig. 22. Culm-sheath of *Dendrocalamus pendulus*. A, outer surface of complete sheath, flattened, × 1/3. B, inner surface of same. C, Outer view of an auricle and adjacent parts of top of sheath and of blade, × 2½. D, inner view, showing part of ligule, with fringe of auricle and part of base of blade behind it.

*Culm-sheaths* to 25 cm. long, rigid except near edges at top, olive green at base grading to pinkish at the top, covered with white waxy powder and with copious felted almost white hairs; *auricles* dark, to about 15 mm. in lateral extent and 3–4 mm. tall, upper edge bearing a close row of slender slightly flexuous pale bristles 15–20 mm. long; *blade* to about 25 by 8 cm., glabrous, pinkish, obliquely ascending, edges incurved, apex acuminate, base slightly contracted; *ligule* 5–10 mm. tall, firm, edge irregularly toothed but not bristly, usually lower in the middle than towards the ends (fig. 22). *Leaf-blades* of smaller branches small, glabrous on lower surface, with few or no bristles on the auricles, of larger branches 15–30 cm. long and 2–3 cm. wide, all leaves with very broadly rounded or truncate base (sometimes almost cordate) above a stalk 2–6 mm. long (distal leaves sometimes cuneate at the base); auricles of larger leaves sometimes bearing bristles to 10 mm. long; ligule short. *Spikelets* in dense heads at the nodes of long slender branches, each spikelet about 10 mm. long, glabrous, with a single perfect floret (rarely 2) and several smaller glumes below it (fig. 23); *lemma* 8–9 mm. long, smooth, with a short stiff point, veins about 12; *palea* of sole floret (or of upper floret if there are 2) thin, glabrous, not keeled, with about 4 veins all near the middle; palea of lower floret (if present) keeled but not fringed; *anthers* 4 mm. long, rather broad, shortly pointed, tips not hairy, filaments very delicate (forming a tube?); *fruit* 4 mm. long, 1·5 mm. wide, smooth except for the truncate top which has short hairs and bears a short hairy beak (base of style).

DISTRIBUTION: very abundant in the valleys of the Main Range, not recorded outside Malaya.

RECORDED MALAY NAME: Buloh akar (in common with all long slender bamboos).

**Uses.** Used for making baskets by Cameron Highlands road, but not used so much as a Gigantochloa. Doubtless used also by forest peoples in many ways, but no study of its particular usefulness has been made. The name Buloh akar is used for some of the slender species of Schizostachyum, and so references to uses of a bamboo with that name may not apply to *D. pendulus.*

This species is undoubtedly very abundant, and of quite uniform character. An aberrant specimen was collected by Symington from Ulu S. Termin (route to G. Korbu, Perak, F.D. no. 32264) at 2,800 ft. The diameter of the culm was said to be 4–5 inches, which is larger than any specimen measured by me, and the lemma of the (single) floret is only 7 mm. long.

The type specimen of *Schizostachyum subcordatum* Ridl. was part of the original collection of *Dendrocalamus pendulus* (Ridley no. 8482) sent to Kew unnamed, later discovered by Ridley when

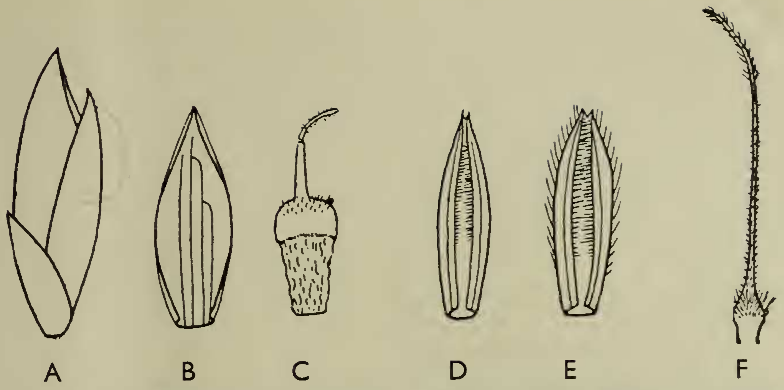

Fig. 23. A, *Dendrocalamus pendulus,* complete mature spikelet (2 empty glumes and a lemma), × 5. B, palea of the single floret from A. C, shrivelled not quite mature fruit from A. D, *D. asper,* palea of uppermost floret. E, *D. asper,* palea of floret next below that shown in D. F, ovary, style and stigma of *D. giganteus,* × 4½.

he was preparing his Flora and re-described. The type specimen of *Cephalostachyum malayanum* Ridl. has large galled spikelet-groups at the ends of leafy branchlets; the spikelets are hypertrophied and each flower contains an insect larva. The arrangement of the parts of the spikelets is exactly as in *D. pendulus,* but lemmas and paleas are very long. The leaves are closely similar to those of normal *D. pendulus,* and I do not think there can be any doubt of the identity of the specimen; it is certainly no Cephalostachyum.

*Specimens:* SINGAPORE, Botanic Gardens, Ridley s.n. 1908 (S); Md. Nur s.n. 1922 (S); Pestana s.n. 1933 (S). NEGRI SEMBILAN, Jelebu, Md. Tahir F.D. 9595 (S). Kenabai Road 39¾ mile, Buyong F.D. 11003 (K). Ulu Bendul, Holttum S.F.N. 9796 (S,K). Seremban District, per A. Arber (K); Kinsey s.n. (K). SELANGOR, Ulu Gombak, Foxworthy F.D. 6431 (S); Burkill S.F.N. 9973 (S,K). Pahang Track, Ridley 8482 (Type, S,K). Ginting Simpah, Holttum S.F.N. 38413 (S); Hume 8434A (S). Ulu Gombak, Hume 8908 (galled infl., S), 9067 (S), 9491 (S). PERAK, Temango, Ridley 14350 (with galled infll., type of *Cephalostachyum malayanum,* S,K); Ridley 14384 (S). Jor Track, Ridley s.n. Nov. 1908 (S). Grik, Hamid F.D. 6427 (S), 11616 (S). S. Termin, 2,800 ft., Symington F.D. 32264 (Kep.). Fraser's Hill, Burkill & Holttum S.F.N. 7892 (S). Cameron Highlands Road 1,000 ft., Holttum S.F.N. 38418 (S). PAHANG, Temerloh, Hamid F.D. 10581 (K). Rompin, Md. Soh F.D. 15456 (S). P. Tioman, G. Kajang, Md. Nur S.F.N. 18914 (S). KELANTAN, Kuala Lebir, Ridley s.n. 12.2.1917 (K).

2. **D. hirtellus** Ridl. in Journ. Str. Br. R. As. Soc. 73: 146. 1916. Flora 5: 266.

Culms to about 15 m. tall and 8 cm. diameter (perhaps also larger), internodes white-waxy when young, apical part of culm very slender and long-drooping with small leaves (7 cm. long).

*Culm-sheaths* dull orange or yellowish towards apex, green at base, covered with pale hairs and white waxy powder when young, the middle ones soon hairless or nearly so, the lowest having brown hairs; *auricles* dark green, more or less crisped, to about 15 mm. in lateral extent and 3 mm. high, edges bearing close nearly straight pale bristles 20–25 mm. long; *blade* of middle sheaths purplish towards base, green distally, commonly 18 cm. long and 2·5 cm. wide, acuminate, base narrowed to about 12 mm.; *ligule* 4–5 mm. high, firm, edge shortly toothed. *Leaves* commonly 20–40 cm. long and 3–6 cm. wide, lower surface velvet-hairy (hairs to 1 mm. long), base broadly rounded in lower leaves, cuneate in upper ones, petiole to 10 mm. long, widening upwards; sheaths glabrous or with some hairs and a waxy covering when young; auricles usually with a few bristles 10–15 mm. long; ligule 1–2 mm. high, slightly toothed. *Inflorescences* usually on leafless branches; internodes of branches glabrous, to 8 cm. long on larger ones; spikelet-groups densely crowded, the larger ones 2·5 cm. diameter. *Spikelets* slender, acute, green, glabrous, 1- or 2-flowered; empty glumes usually 2, the upper nearly as long as the lemma and shortly apiculate; *lemma* 7·5 mm. long including a pale tip of less than 1 mm.; upper or sole *palea* a little shorter, with 4–7 veins unevenly spaced, not keeled; palea of lower floret, if present, keeled but not fringed; *anthers* hardly 4 mm. long, tips not hairy, filaments free or sometimes apparently forming a tube; *ovary* nearly spherical, top sparsely hairy, stigma undivided; *fruit* with truncate slightly hairy top.

DISTRIBUTION: Johore, Taiping, Kedah and Kelantan, in open places in forest.

RECORDED MALAY NAME: Buloh kapor.

The type of this species was found at Genuang in northern Johore. It is not at Singapore, and I have not found it at Kew. I think however there can be no doubt it was of the same species as numerous plants which flowered abundantly between Labis and Segamat (very near the type locality) in October 1946; the above description was prepared from these plants. No other Dendrocalamus has been found in northern Johore. I propose therefore to regard Henderson's collection (S.F.N. 38201) as a neotype. I made notes on culms and culm-sheaths from the plants in situ. These plants were growing in forest which had been cleared during the Japanese occupation of Malaya. The cutting and exposure doubtless stimulated them to flower.

I subsequently found a few plants in Kedah, mostly in bamboo thickets in the north of that State, which resembled the Johore plants in essentials, but differed in details of size of auricles and ligule on the culm-sheaths. One plant had auricles 13 mm. high (normal height in this species is 3–4 mm.) with very short bristles (5–7 mm. instead of 20–25 mm.), and ligule to 13 mm. high; another had normal auricles but the ends of the ligule 15–20 mm. high, deeply incised. Those plants from Kedah which I found in flower agreed with the Johore plants. A flowerless plant from Taiping Hills also agreed in essentials with the Johore plants, but had short bristles on the auricles and a ligule only 4–5 mm. tall; the sheaths may not have been representative of the full development on that plant. Other plants which might pass vegetatively for *D. hirtellus* are here included under *D. sinuatus,* because of the larger number of flowers in the spikelets, and hairiness of lemma and palea. Vegetative characters have been insufficiently studied in *D. sinuatus.* If such study confirms that there is no clear distinction between the species, then they should probably be united, under the earlier name *sinuatus.*

*Specimens:* JOHORE, Ulu Kahang ,Lake & Kelsall s.n. 1892 (S). G. Panti, 2,000 ft., Ridley s.n. Dec. 1892 (S.) G. Pulai, Holttum S.F.N. 38437 (S); Ridley s.n. Dec. 1905 (S). Near Labis, Henderson S.F.N. 38201 (Neotype, S,K, Kep.); Holttum S.F.N. 37790 (S), S.F.N. 38308 (S). KELANTAN, Near Kampong Kando, Symington F.D. 37815 (S). KEDAH, Sungei Patani, Wolfe & Abdul Kadir S.F.N. 21466, 21469 (S). Sintok Road, Holttum s.n. 26.10.1946. Bukit Jamboi, 700 ft., Holttum S.F.N. 19816 (K,S). PERAK, Maxwell's Hill, Wyatt-Smith F.D. 76179 (Kep.).

3. **D. elegans** (Ridl.) Holttum in Gard. Bull. Singap. 11: 296. 1947.

Basonym: *Schizostachyum elegans* Ridl. in Journ. Str. Br. R. As. Soc. 73: 146. 1916. Flora 5: 271.

*Culms* to about 6 m. long and 2·5 cm. diameter, smooth, walls thick, upper part drooping, internodes to at least 26 cm. long. *Culm-sheaths* not known. *Leaf-blades* to 12 by 1·2 cm., base rounded or broadly cuneate, stalk very short (0·5–1·5 mm.), lower surface densely and shortly velvet-hairy; auricles small, sometimes with slender bristles; ligule short, edge nearly smooth. *Inflorescences* on tufted branches 10–20 cm. long at the nodes of the culms, flowering and leafy branches sometimes from the same node, the spikelets in dense groups 5–20 mm. apart. *Spikelets* about 8 mm. long and 1·5 mm. wide near the base, terete, glabrous; perfect florets 1 or 2; *lemma* of upper or sole floret 7 mm. long, of lower floret (if present) shorter, short-pointed; *palea* of lower floret 2-keeled, short-hairy on the keels, 2 veins between the keels; palea of upper or sole floret not keeled, glabrous, about as long as lemma, with 4 veins; *anthers* 6, a little more than 2·5 mm. long;

*ovary* gradually contracted at the apex, smooth, style very slender, smooth, ending in a single plumose stigma.

DISTRIBUTION: described from a flowering specimen from a plant cultivated in the Waterfall Garden, Penang, origin Langkawi (Burkill, S.F.N. 785, S,K.); also collected in flower on limestone on Pulau Timun, Langkawi, by Henderson (S.F.N. 29097, S,K).

This species appears to be very near *D. dumosus* vegetatively, but differs in its softly hairy leaves, which appear also to be smaller and with even shorter stalks. In flower-structure, *D. elegans* appears always to have 6 stamens, with somewhat shorter anthers than in *D. dumosus,* and the apex of the ovary is quite glabrous. It also often has two florets, with keeled palea hairy on the keels, a feature not seen in *D. dumosus;* and the paleas of upper florets examined by me had 4 veins only. Culm-sheaths of the two species need to be compared.

4. **D. dumosus** (Ridl.) Holttum in Gard. Bull. Singap. 11: 296. 1947.

Basonym: *Schizostachyum dumosum* Ridl. in Journ. Str. Br. R. As. Soc. 61: 64: 1912. Flora 5: 271.

*Culms* 2–2·5 cm. diameter, thick-walled, *Culm-sheaths* thin, to 18 cm. long, back rather sparsely covered with appressed dark hairs, top of sheath little over 1 cm. wide; *auricles* small, bearing bristles 5 mm. long; *ligule* 1·5 mm. tall, with toothed edge bearing slender bristles near each end; *blade* 3–5 mm. wide, reflexed. *Leaf-blades* commonly to 18 by 1·8 cm., sometimes to 23 by 3 cm., surfaces not hairy, base rounded to cuneate, stalks of upper leaves to 2·5 mm. long (lowest leaves almost sessile); auricles small, sometimes with a few fine bristles 5–8 mm. long; ligule short. *Spikelet-groups* at the nodes (5–15 mm. apart) of smooth leafless branches 7–15 cm. long from the nodes of the slender upper part of the culm. *Spikelets* 1-flowered, with about 4 glumes of increasing size below the lemma; *lemma* 7 mm. long, with a short stiff point, almost completely enfolding the palea; *palea* 7 mm. long, thin, glabrous, not keeled, with about 7 veins; *stamens* varying from 3 to 6, anthers 3·5 mm. long; *ovary* glabrous, with a narrowly conical slightly hairy apex connecting it to the very slender sparsely hairy style; *fruit* 5·5 mm. long, cylindric, glabrous except for short hairs on the truncate apex.

DISTRIBUTION: Rawei Island, Langkawi, and Baling Hill (South Kedah), on limestone.

The original collection was from Rawei Island, in the Adang group, west of Terutau (Siamese territory), where Ridley reported it "on a dry rock face of the island, forming dense thickets, the stems usually short, 6 or 7 feet, but sometimes much longer". Flowering plants agreeing with the type were later found on Baling Hill; the culm-sheaths described above were from a flowerless Baling plant, so there is a little doubt whether they belong here. A flowerless specimen from Langkawi which agrees vegetatively with the Baling plants has also been here included.

Ridley stated that his specimens had three stamens with connate filaments; but of two spikelets examined by me one had five, the other six stamens, and the filaments (still not expanded) appeared to be free. The Baling specimens also appear to have free filaments. For differences from *D. elegans,* see that species.

*Specimens:* RAWEI Island, Ridley 15903 (S,K, Type collection). KEDAH, Langkawi, Batu Ayam, Corner S.F.N. 37839 (S). Baling Hill, 700–1,000 ft., Nauen S.F.N. 38017 (S); half-way up, Corner & Nauen s.n. 25.11.1941 (S); summit, Corner & Nauen s.n. 25.11.1941 (flowering, S); summit, Kiah S.F.N. 35409 (S,K).

5. **D. sinuatus** (Gamble) Holttum in Gard. Bull. Singap. 11: 296. 1947.

Basonym: *Oxytenanthera sinuata* Gamble in Ann. R. Bot. Gard. Calc. 7: 71, pl. 62. 1896. Ridley, Flora 5: 264.

*Culms* apparently waxy near tops of internodes when young. *Culm-sheaths* rigid, when young covered with rather fine loose brown hairs, smooth when old; *blade* relatively narrow, slightly constricted near base and decurrent on each side as a narrow band close to the top of the sheath, ending in firm *auricles* 2–4 mm. high bearing stiff bristles; *ligule* stiff, toothed, the teeth perhaps prolonged into bristles, undivided part to 5 mm. high. *Leaf-blades* commonly 20–30 cm. long and 3–4·5 cm. wide, base broadly rounded and then decurrent on a broad often hairy stalk 5–10 mm. long, lower surface hairy throughout; auricles sometimes with slender bristles; ligule short, edge irregularly toothed. *Spikelet-bearing branches* long, slender, pendulous, internodes short-hairy; *spikelets* to 13 mm. long, slightly flattened, 2·5 mm. wide, narrowed evenly to pointed apex, glumes and lemmas stiffly pointed (longest points on upper lemmas), surfaces with very short fine erect hairs or not; empty glumes usually 3 or 4; *florets* 3 or 2, all perfect; *lemmas* to 11 mm. long; *paleas* to 10 mm. long, narrow, the lower ones with hairy keels, 2–4 veins between keels and one between each keel and edge, uppermost palea keeled towards apex only, with a few short hairs on the keels; anthers 5–6 mm. long, apiculate, tip toothed or short-hairy, filaments before extension adherent, the tube when extended very delicate; top of *ovary* and base of style rather long-hairy; *fruit* glabrous below the truncate hairy apex.

DISTRIBUTION: Malaya, Annam; in Malaya known from three flowering collections (as listed below) from Negri Sembilan and Pahang; two sterile specimens, from Grik and Kemaman, may also belong here.

RECORDED MALAY NAME: Buloh akar.

As noted in the generic discussion, this species is very closely related to *D. pendulus* and *D. hirtellus,* agreeing with the latter in its rather large hairy leaves and probably also in its white-waxy young culms. All the flowering specimens agree in the larger number of florets, and also in hairiness of lemmas and paleas and longer anthers (but in Dendrocalamus the upper florets are always longer than the lower, so longer anthers may merely be correlated with a larger number of florets). Careful notes on culm-sheaths and other vegetative characters of plants identified from their flowers are needed. I have never collected specimens of this species, and the above description of the culm-sheath is made from rather inadequate dried specimens.

*Specimens:* NEGRI SEMBILAN, Seremban, Alvins 1988 (S, Type). PAHANG, Raub, Burkill & Haniff S.F.N. 16895a (S). Sungei Chelia, Chigar Perah, Henderson S.F.N. 19373 (S). TRENGGANU, Kemaman, Sungei Nipa, Corner S.F.N. 30545 (S). PERAK, Grik, F. R. Hamid, F.D. 8258 (S,K).

6. **D. strictus** (Roxb.) Nees in Linnaea 9: 476. 1834. Gamble in Ann. R. Bot. Gard. Calc. 7: 78, pl. 68, 69. Backer, Handb. Fl. Jav. 2: 280.

Basonym: *Bambos stricta* Roxb., Corom. Pl. 1: 58, t. 80. 1798.

*Culms* growing very close together, 10–15 m. long, much curved (not stiffly erect), 2·5–7·5 cm. diameter, thick-walled; internodes pale blue-green when young, dull green when old, 30–45 cm. long, nodes somewhat swollen, some of the lower nodes often bearing branches. *Culm-sheaths* with rather sparse golden brown to dark hairs or almost hairless, rounded at the top; *auricles* small and short-hairy, not bristly; *blade* erect, triangular, with stiff narrow tip; *ligule* 2–3 mm. high, edge toothed, not bristly (fig. 24). *Leaves* to 25 cm. long and 3 cm. wide, lower surface short-hairy; auricles sometimes with a few slender bristles; ligule low. *Spikelets* borne in dense groups up to 2·5 cm. diameter on branching leafless axes; *perfect florets* 2 or 3; *lemmas* about 8 mm. long, densely and minutely hairy towards apex, ending in a sharp spine 2 mm. long; *paleas* of lower florets 2-keeled, ciliate on the keels and hairy on surface near tip, uppermost palea not keeled, often nearly glabrous; *anthers* 3 mm. long, filaments free; *ovary* hairy at top, style long, bearing a single stigma; *fruit* ovoid, 7·5 mm. long.

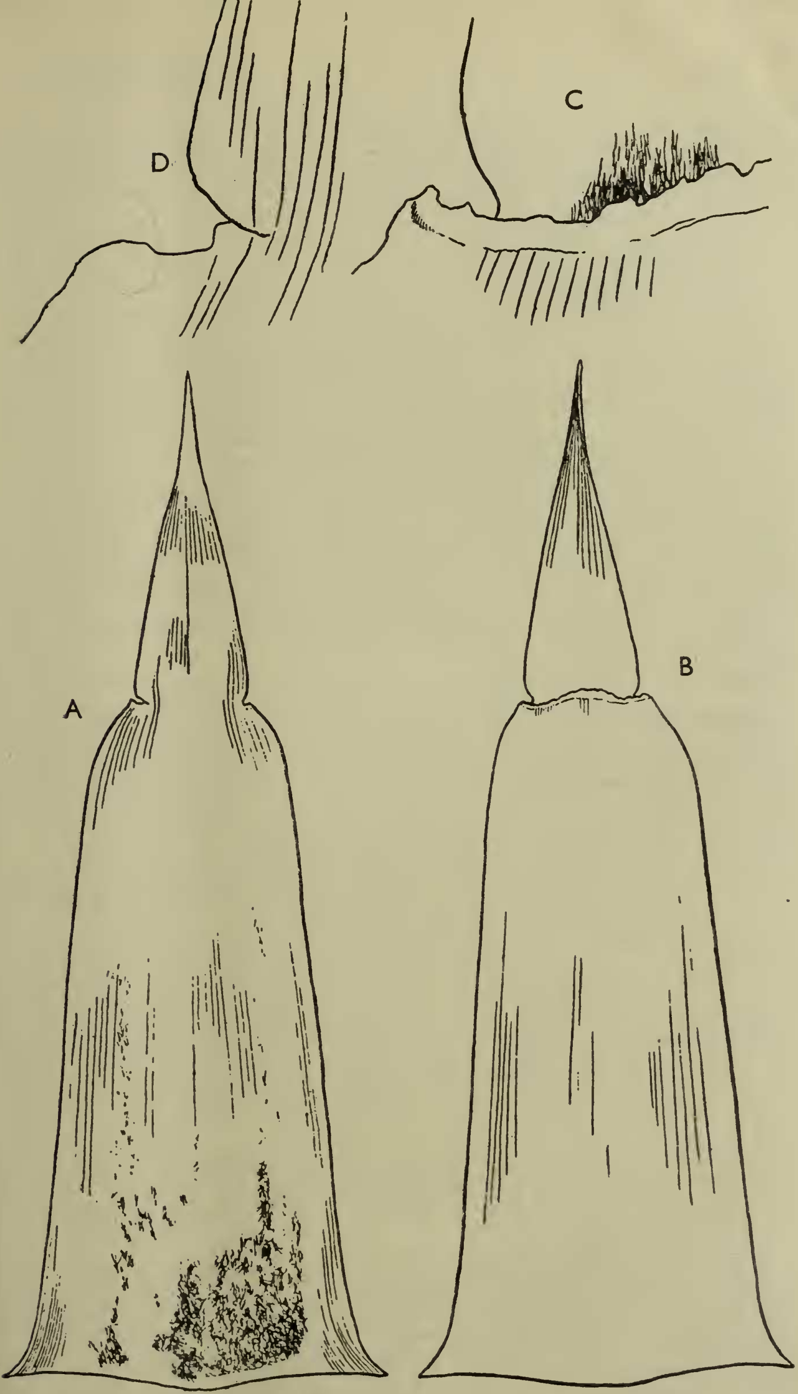

Fig. 24. Culm-sheath of *Dendrocalamus strictus*. A, outer surface of complete flattened sheath, × 1/3. B, inner surface of same. C, inner surface of top of sheath, showing part of ligule and base of blade, × 3. D, outer surface of part of top of sheath and base of blade (auricle hardly developed).

DISTRIBUTION: throughout India; perhaps occasionally planted in Malaya, but there are no certain records apart from plants in the Public Gardens at Kuala Lumpur (several large clumps) and the Botanic Gardens, Singapore. A clump in the Residency garden, Penang, flowered heavily in 1938; whether it died after flowering is not certain. (Abdul Kadir, S.F.N. 36176, S,K, Kep.). The plants at Kuala Lumpur and Singapore sometimes flower a little on leafy branches, and no general flowering has been noted, though the clumps at Kuala Lumpur must be much more than 30 years old.

In the Botanic Gardens, Singapore, are two plants believed to represent different forms of this species, agreeing in their rather slender thick-walled culms, glaucous when young, branched at all nodes nearly to the base, and sheaths of the shape above described. They differ in their mode of branching, one with horizontal branches, the other with the main branch from each node strongly deflexed; the former plant has copiously hairy sheaths, the latter almost glabrous ones. One of the Singapore plants is growing in quite wet ground, and still has very thick-walled culms, though Gamble says that *D. strictus* has thinner-walled culms in wet places.

Gamble remarks as follows of this species: "this is the most common and most widely spread and most universally used of all the Indian bamboos, and is commonly known as the male bamboo. Its culms are employed for all purposes of building and furniture, for mats, baskets, sticks and other purposes". Further planting of *D. strictus* in Malaya would be worth trying.

7. **D. asper** (Schult.) Backer ex Heyne, Nutt. Pl. Ned. Ind. ed. 2, 1: 301. 1927. Handb. Fl. Jav. 2: 279.

Basonym: *Bambusa aspera* Schult., Syst. Nat. 7: 1352. 1830. Kurz in Journ. As. Soc. Beng. 39, pt. 2: 87. 1870.

Synonyms: *Dendrocalamus flagellifer* Munro in Trans. Linn. Soc. 26: 150. 1866. Gamble in Ann. R. Bot. Gard. Calc. 7: 91, pl. 80. 1896. Ridl., Flora 5: 265.

*Gigantochloa aspera* Kurz in Ind. Forester 1: 221. 1876. McClure in Fieldiana, Botany, 24, pt. II: 141. 1955.

*Culms* to 20 m. tall, when young (and persistently near base) covered with fine closely appressed brown hairs, later green, near the base commonly 12 cm. diameter and often more, lower nodes usually bearing many roots; middle internodes 40–50 cm. long. *Culm-sheaths* on upper part of culm 30–40 cm. long, very pale green when young, sparsely covered with loose pale hairs, hairs at base of sheaths darker, lowest sheaths rather densely covered with dark brown hairs; *blade* reflexed, narrow (on a lower sheath 8 by 1·7 cm., on an upper sheath 25 by 3·5 cm.), on lower sheaths hardly narrowed at base, base crisped and extending laterally to slightly crisped *auricles* up to 2 cm. in lateral extent and 7 mm. high, bearing rather slender bristles about 5 mm. long; *ligule* 7–10 mm. high and beyond this a fringe of fine hairs 3 mm. long (fig. 25). *Leaf-blades* commonly to 30 cm. long and 2·5 cm. wide, base of lower ones unequally cuneate above a stalk 3–5 mm. long, lower surface sometimes rather sparsely hairy near the base, often quite glabrous; auricles small, not bristly; ligule about 2 mm. high, entire or with teeth or bristles. *Spikelets* usually on long leafless short-hairy branches, in small nearly spherical and rather dense groups, each spikelet 6–9 mm. long, flattened, 4 mm. wide, apex blunt; empty *glumes* 1 or 2; *florets* 4 or 5, also often a reduced sterile apical floret; *lemmas* broad, fringed with pale hairs towards apex, back covered with short fine hairs, upper lemmas longer than lower, uppermost to 8 mm. long; *paleas* about as long as lemmas, keeled, fringed on keels and edges, outer surface fine-hairy towards apex (edges of palea of upper-most floret fringed but keels not fringed), veins between keels 1–3, between keels and edges 1 or 2 (fig. 23 D, E); *anthers* 3–5 mm. long (longer in upper florets) with short glabrous tip; *ovary* and style hairy, style undivided.

DISTRIBUTION: much planted throughout Malaysia for its edible young shoots; native country not certainly known, but possibly northern Malaya and neighbouring regions (an apparently wild plant found near Cameron Highlands).

RECORDED MALAY NAMES: Buloh Bĕting, Buloh Bĕtong; in Singapore known as Rĕbong China (cultivated by Chinese).

Schultes' name *B. aspera* and his description are based entirely on Rumphius, who described this species in Amboyna. He stated that it was planted from cuttings, but also thought it to be native. Backer states that he doubts whether it is wild in Java, as no seeds have ever been seen. I found a plant (not flowering) which agreed in vegetative characters with this species in the forest at 3,000 ft. near the road to Cameron Highlands (S.F.N. 38416). This plant could have been planted; but as it was in apparently primitive forest it could also be native. Further evidence is needed. I think Rumphius's description is sufficient to indicate the present species, as no other is so universally cultivated for edible purposes.

Gamble states that he has found one or two lodicules in some spikelets, but I have never seen them in the many spikelets I have examined. Gamble also figures three stigmas, a condition I have not seen. The spikelets on a single inflorescence may vary in the presence or absence of an imperfect terminal floret, which is borne

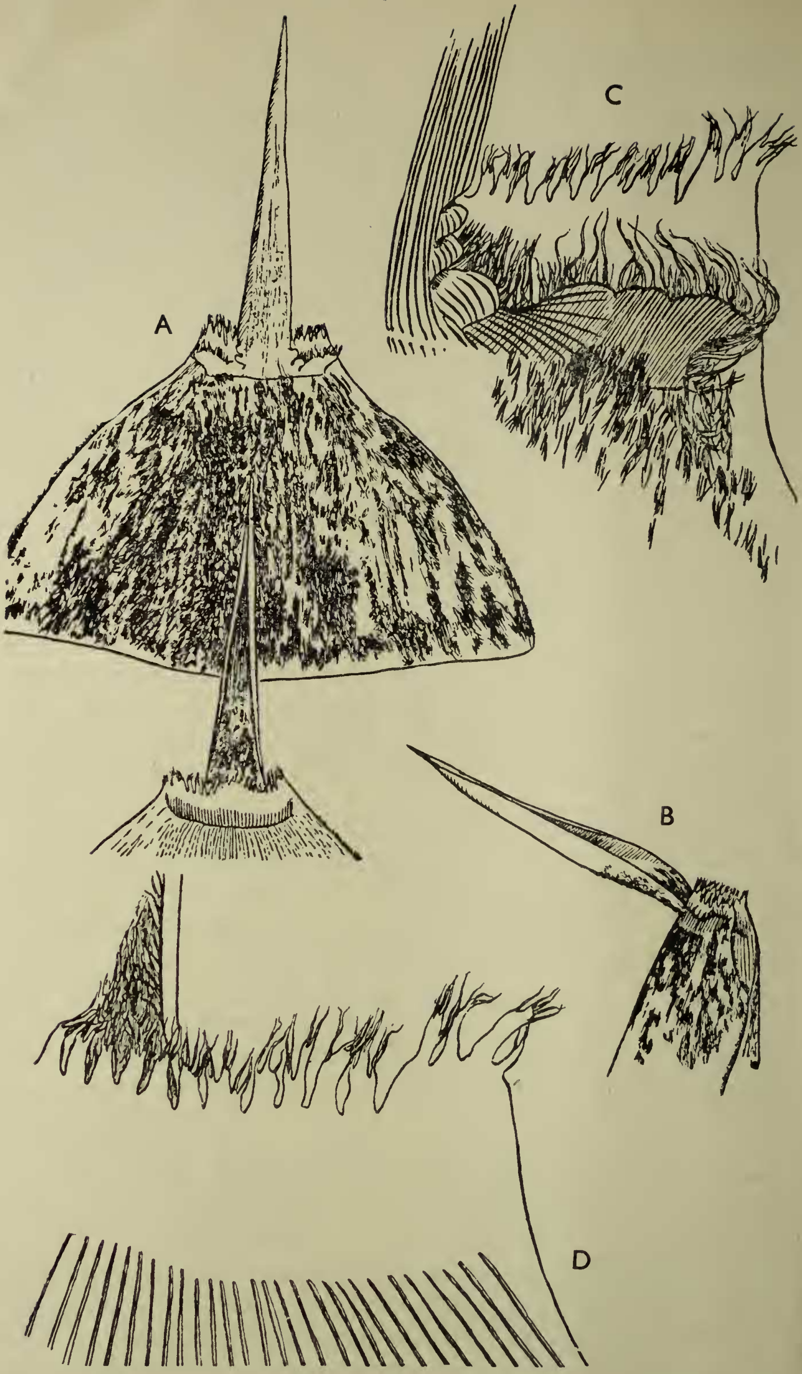

Fig. 25. Culm-sheath of *Dendrocalamus asper*. A, outer surface of complete flattened sheath, with inner surface of blade and top of sheath superposed. B, top of sheath and blade in natural position, × ½. C, outer view of part of top of sheath, showing auricle overtopped by fringed ligule, × 3. D, inner view of end of ligule, with part of base of blade.

on a continuation of the rachilla about 1·5 mm. long. The imperfect floret varies in character; in one case I found in it 3 stamens and a rudimentary ovary. McClure, when placing this species in the genus Gigantochloa, did not explain his reasons for so doing.

The persistent brown-hairy covering of the bases of the culms, and the many roots on the lower nodes, appear to be distinctive. The pale green sparsely hairy sheaths on the upper parts of unbranched young culms are also very striking. The only other bamboo I have found which could be confused with this one is *Gigantochloa levis,* under which are notes on distinguishing characters.

In addition to the edible shoots of this species, the old culms are also useful, being large and very strong.

*Specimens:* Singapore, Experimental Nursery, Ridley 454 (S). Lower Garden, Ridley 3945 (S,K), 10644 (S). Deer Shed, Botanic Gardens, Ridley 5603 (S,K). Ang Mo Kio, Ridley 6681 (S,K). No locality, Ridley 2929 (K); Cantley 2939 (S). Burkinshaw's Jungle, Ridley s.n. 27.5.1893 (S). Tanglin Hill, Burkill s.n. 1.5.1913 (S). Jurong Road, G. F. Hose 88 (S); Hullett 486 (S,K). Adam Road, Kiah s.n. 23.12.1932 (S,K). Dunearn Road, Pestana s.n. 15.10.1932 (S). Bukit Brown, Pestana s.n. Oct. 1933 (S). Malacca, Alvins 115 and s.n. (S). Gaudichaud, s.n. (K). Griffith, s.n. (K). Bukit Sabukor, Derry 101 (S). Bukit Bruang, Alvins s.n. 20.1.1886 (S). Perak, Taiping, Strouts F.D. 9987 (Kep.). Cameron Highlands Road, 3rd mile, Holttum S.F.N. 38425 (S); 3,000 ft., Holttum S.F.N. 38416 (S). Penang, Batu Feringhi, Ridley & Curtis 8363 (S,K). Balik Pulau, Ridley 9460 (S). Batu Feringhi Road, Birch s.n. 27.3.1900 (S); Curtis 3565 (S,K), 3566 (S,K). No locality, Flippance s.n. 28.6.1934 (S).

8. **D. giganteus** Munro in Trans. Linn. Soc. 26: 150. 1868. Gamble in Ann. R. Bot. Gard. Calc. 7: 87, pl. 76. Ridl., Flora 5: 265. Backer, Handb. Fl. Jav. 2: 281.

*Culms* to 30 m. tall, 18–25 cm. diameter near base, walls to 2·5 cm. thick, when young covered with a white waxy layer. *Culm-sheaths* 25–50 cm. long, dark-brown-hairy on the back; *blade* spreading at right angles, narrowly triangular on sheaths 6 ft. above ground, stiff, edges inflexed towards stiff acuminate apex, base widened into large brown strongly crisped *auricles* which are not bristly; *ligule* 8–12 mm. high, stiff, dark, bearing a short fringe. *Leaf-blades* commonly 40 cm. long and 6 cm. wide, lower surface slightly rough with distinct cross-veins, petiole to 5 mm. long; auricles small and glabrous, ligule to 3 mm. high, irregularly toothed. *Spikelets* in groups of about ten at the nodes of finely hairy branches; detached mature spikelets 13–17 mm. long, flattened, 4–5 mm. wide; empty glume one (fig. 26); *florets* 4–6, the uppermost one sometimes imperfect in varying degrees down to a small rudiment; *lemmas* broad, 8–13 mm. long with a short firm tip, edges very shortly fringed, back bearing short fine hairs;

*paleas* with long-fringed keels, rather narrow inflexed finely fringed edges, short hairs all over back, 2–3 veins between the keels (uppermost lemma only slightly keeled); *anthers* 7–10 mm. long, tips pointed; *fruit* 7–8 mm. long with blunt hairy apex.

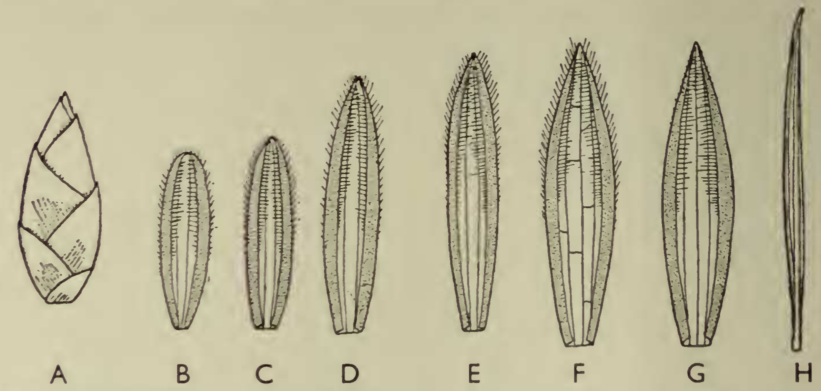

Fig. 26. *Dendrocalamus giganteus*. A, complete spikelet, × 2. B–G, paleas of its six perfect florets, in order (lowest on left), × 3. H, imperfect terminal floret, × 3.

DISTRIBUTION: Lower Burma; reported by Ridley as native in Malaya but evidence for this cannot be found.

The above description was prepared from a fine clump planted at the Forest Research Institute, Kepong, Selangor, probably introduced by the late Dr. F. W. Foxworthy; the clump flowered in the years 1951–1953 (Wyatt-Smith, F.D. 55798, Kep; E. F. Allen s.n., S). I have also seen plants (not flowering) in the Botanic Garden at Bogor in Java. This most spectacular bamboo should be planted for ornamental purposes in Malaya, and it might well find practical uses also. There are specimens taken from a plant formerly in Government House Domain, Singapore (Anderson s.n., February 1914; S,K); this plant disappeared before 1922.

## GIGANTOCHLOA

**Gigantochloa** Kurz ex Munro, Trans. Linn. Soc. 26: 123. 1868.

Type species: *G. atter* Kurz ex Munro, l.c. 125, from Java; see also Kurz in Indian Forester 1: 344. 1876. Holttum in Taxon 5: 28–30. 1956.

*Culms* close and erect, mostly of medium size, forming dense clumps, the upper parts curved outwards but never with very slender pendulous tips, lower part of culm always unbranched, upper part with small branch-groups at the nodes; walls of moderate thickness; young culms often bearing scattered coarse hairs on their exposed parts, in *G. apus* a close covering of pale hairs. *Culm-sheaths* usually dark-hairy, often with loose hairs; auricles in nearly all cases low (often elongate laterally) and very firm, dark green when young, with or without marginal bristles; blades of middle sheaths usually rather narrow, sometimes green and leaf-like; ligule well developed, usually thin and more or less lacerate, or with marginal teeth. *Spikelet-groups* usually on leafless branches (often a whole culm bears flowers and no leaves); *spikelets* consisting of several basal bracts and glumes, 2–5 perfect florets and a terminal narrow empty lemma, the rachilla-internodes all very short (under 0·5 mm.), the lower lemmas shorter than the upper ones, the terminal empty lemma longest of all (fig. 27); *lemmas* usually fringed, apiculate, many-veined; *paleas* thin and translucent, all strongly keeled, narrow between the keels and with narrow inflexed edges, keels usually fringed; *stamens* 6, the filaments joined to form a firm tube which at flowering is a little longer than the palea, anthers long, with a distinct tip; *lodicules* usually absent; *ovary* with hairy top; style long, usually ending in a single hairy stigma; *fruit* narrowly cylindric, hairy at the top only, pericarp thin towards the base and showing position of small round embryo, slightly grooved down the other side along the line of the hilum.

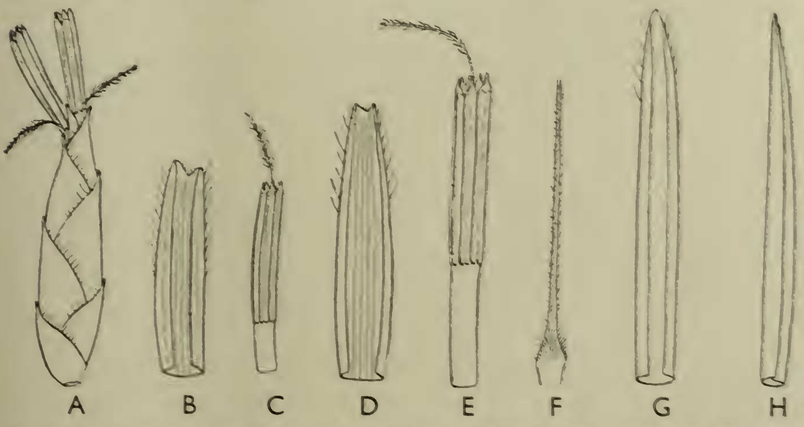

Fig. 27. *Gigantochloa wrayi*. A, complete spikelet with stamens and stigmas protruding from two florets, × 2½. B, palea of lowest floret, × 3. C, floral parts from B (ovary hidden by stamen-tube) before anthesis. D, palea of floret next above B. E, floral parts from D. F, ovary and style from D. G, palea of uppermost perfect floret. H, empty lemma which represents terminal floret.

I have selected *G. atter* as the type species, because Munro's first species, *G. verticillata*, is a mixture; see discussion under *G. maxima*, below.

This genus appears to be confined to the region of Burma, Siam and Indochina southwards to Malaya. Several species (or clones?) are planted in Java, and one in North Borneo and the Philippines, but these are not native and were probably brought from the region of Lower Burma. In Malaya I have seen no wild plants south of Tampin (i.e., the southern end of the Main Range); as one goes northwards the variety of Gigantochloas increases, and in the north of Kedah and Perlis they are very abundant in the bamboo thickets near Sintok and elsewhere. My impression is that hybrid swarms of Gigantochloa occur in the north of Malaya; the variety of plants in the Sintok region is quite bewildering. Besides native plants, which are locally very abundant on edges of forest and in clearings, several Gigantochloas are common village plants in all parts of Malaya; some of them have probably been propagated from wild plants in the neighbourhood, some (like the Gigantochloas of Java and the Philippines) brought from more remote areas. The planted Gigantochloas are undoubtedly indications of the migrations of men, and as such are of considerable potential interest.

But the species of Gigantochloa are difficult to characterize clearly; and there is no doubt that their area of greatest abundance is in Lower Burma and Peninsular Siam, where they have been little studied in the field. Malay Peninsula species in fact cannot be properly understood until those of the region further north have been carefully studied. And even those species which exist in Kedah need much more field study; the present treatment is no more than a tentative one.

The form of spikelet is very constant throughout the genus; vegetative form is more variable, and in fact bamboos with quite different vegetative characters may bear almost identical spikelets. Backer's solution has been to include in one species all plants with the same kind of spikelet; this is perhaps inevitable, but it does not help the man who wants to distinguish bamboos by vegetative means for practical uses. The distinct vegetative forms, whatever taxonomic rank they are given, need to be described. The various forms included by Backer under *G. verticillata* are apparently well known by name to village people in Java (though I do not find that they have yet been clearly distinguished in botanical descriptions), and are in fact clones, propagated vegetatively. They may be particular forms of variable natural species or of hybrid swarms; and it may even be that new forms have arisen by the germination of chance seeds in Java (though fruits are not abundant, they are certainly produced occasionally). The largest form of *G. verticillata* (in Backer's sense), said to be widely planted in

Java, is not generally planted in Malaya (I have only seen a colour-variant of it, at Kota Tinggi in Johore), nor have I seen any indication that it is wild in Malaya; its origin must be sought further north. The same is true of *Gigantochloa apus,* said to be the most useful species in Java and one of the most distinct vegetatively of all Gigantochloas; the only plants I have seen in Malaya are at the Botanic Gardens, Singapore, and at Serdang, brought in both cases from Java in recent years. Gigantochloas will never be properly understood until a plantation, made from many plants from many localities, is established and studied over a period of years; and most probably also it will be necessary to plant seedlings, to discover the extent of a heterozygous condition in the genus. That however is counsel of perfection. The practical thing needing to be done first is to select some clones which are good for village planting, for particular purposes, and to propagate them and test them. This genus provides more useful bamboos than any other in Malaya.

The genus Gigantochloa has traditionally been separated from Dendrocalamus by the supposed condition of the fruit. Munro proposed a new sub-tribe *Bacciferae* (subdivided and re-named by Bentham, but essentially unchanged) to include bamboos with a fleshy pericarp in which the position of the embryo is not externally visible; he placed Dendrocalamus in this sub-tribe, and Gigantochloa (with Bambusa) in a sub-tribe of genera having a thin pericarp through which the position of the embryo could be seen. I have compared fruits of *Dendrocalamus pendulus* and *Gigantochloa wrayi,* and I can see no difference whatever in essential structure. In both cases the pericarp is very thin towards the base and the position of the embryo is clearly seen through it. This is true also of *Dendrocalamus hamiltoni* and of other species of which fruits are figured and described by Gamble. Having removed this supposed difference, one has to place the two genera near together, and to find another basic distinction between them. That this is not easy is indicated by the fact that Munro and Gamble placed in Oxytenanthera a group of Asiatic species some of which are Dendrocalamus and some are Gigantochloa, as defined in the present work (true Oxytenanthera is confined to Africa, and is characterized by a quite different kind of ovary).

The presence of a stamen-tube is a possible distinction. But in fact it is not at all easy to observe, and as it occurs also in the very different genus Schizostachyum (or in Neohouzeaua, if one keeps that as a separate genus) I do not think it is necessarily an important character. I find that the distinctive feature of the Gigantochloa spikelet is the presence of the rudimentary terminal floret in the form of a long narrow empty lemma, longer than the uppermost fertile lemma. Owing to the presence of this lemma, the palea of the uppermost perfect floret, which backs on to it, is two-keeled like the rest. In Dendrocalamus, the last floret is usually perfect, in which case the palea has no further structure behind it and is generally not keeled; or if a rudimentary floret is present, it is of variable form and the uppermost palea is slightly keeled. In some species of Dendrocalamus, as so separated, there is a delicate stamen-tube, much less easy to see than that of Gigantochloa. The rather firm stamen-tube in Gigantochloa is thus, I think, a good character.

In the fruit of *G. wrayi* and *G. ligulata,* the apical part of the pericarp is much the thickest part, and is separated by a distinct gap from the top of the seed. Towards the base of the fruit the pericarp is quite thin, in close contact with the seed, but in the almost ripe fruit it can be separated easily from the seed (the separation is not easy in a dried herbarium specimen). The pericarp is thin enough to show the position of the small round basal embryo quite clearly. Apart from the embryo, the other external features of the fruit are three very slight and narrow ridges (grooves in the dry fruit), representing the course of the median vascular bundles of the three carpels, and a broad darker band (slightly depressed in the dry fruit) on the side opposite the embryo, representing the position of the vascular tissue which supplies the developing seed all along the linear hilum (see section in Arber, *The Gramineae,* p. 122, fig. B1).

The fruit of Bambusa also is essentially similar in structure to that of Gigantochloa and Dendrocalamus, but Bambusa differs in spikelet-form, having elongated rachilla-internodes and lemmas all about the same length; it has also paleas of firmer texture (the paleas of Bambusa are partly exposed, but quite hidden in Gigantochloa) and often a short style with three stigmas. One species which in these characters belongs to Bambusa has been placed in Gigantochloa because of the presence of a stamen-tube (*G. heterostachya* Munro); as with the species of Dendrocalamus having this character, I consider that the weight of the other evidence is more important in deciding the relationships of this species, and include it in Bambusa.

**Field characters.** Most Gigantochloas are moderate-sized bamboos with very straight culms growing close together, the tops of the culms never very thin, pendulous and whip-like, as in Schizostachyum. The culm-sheaths are usually not so thick as those of Dendrocalamus and are pale papery-brown when old. The auricles are nearly always low and very firm, dark green when young; the exception is the apparently little-planted *G. levis,* which has raised auricles more like those of the larger species of Dendrocalamus. The ligule is often tall and very thin, deeply lacerate in part, and thus of fragile nature not easily preserved intact in herbarium specimens. The blade is either erect or deflexed; blades from the middle of a culm upwards are often green and leaf-like. The culm walls are of varied thickness, never very thin, and they do not split so readily as those of Schizostachyum. In Schizostachyum the walls are not only thin; the fibres are mainly concentrated in a dense thin layer near the surface, the fibres of the inner vascular bundles less well developed. In Gigantochloa, as in Bambusa, there is a much more gradual lessening of fibrous structures in the inner parts of the wall of the culm; the bundles are more widely spaced as one passes inwards from the very dense layer near the surface, but each bundle has equally large and strong fibre-groups. The result is that the wall of the culm in Gigantochloa and Bambusa is of much more even structure than in Schizostachyum, and this allows their use in particular ways, as mentioned below.

Spikelets of Gigantochloa are usually on all branches of a single culm. They are of moderate size, and the fringed lemmas are often distinctive. Sometimes the end of the stamen-tube can be seen protruding beyond the tip of a lemma at the flowering stage.

In the region of Selangor and Lower Perak young culms of the abundant species *G. scortechinii* are conspicuous by the contrasting colours of their sheaths, bright orange near the top and covered elsewhere by glistening brown-black hairs, the exposed parts of the culms themselves often pale glaucous green. Further north other species appear, especially *G. ligulata* in its varied forms. In open country in Kedah, typical small *G. ligulata* is the common bamboo, with its large leaves and very long leaf-ligules.

**Uses.** The larger Gigantochloas have strong culms useful for general structural purposes, agreeing in quality in this matter with *Bambusa arundinacea.* Hildebrand states that the culms of *G. apus,* though somewhat smaller than those of *G. maxima,* are more durable. Neither of these is common in Malaya, but probably the large forms of *G. ligulata,* and *G. scortechinii,* are of comparable quality. Gigantochloas with walls not too thick are used for making floors and walls of houses, by a process of splitting and flattening. The medium-sized Gigantochloas, with walls not too thick, are probably the bamboos most in use for basket-making, and here the structural character of the culm-wall, described above, is important. The culms are first split along radial planes to strips of suitable size, and then these are split tangentially (i.e., in a plane parallel to the surface). The rather uniform texture of the culm-walls makes this latter form of splitting possible, and provides thin flexible strips of varying width which can be used for weaving the sides of baskets.

Some Gigantochloas give good edible shoots (these are said to be *manis* by Malays); the shoots of others are astringent (*kĕlat*) or bitter (*pahit*). My impression is that clones of very similar vegetative form may differ in edible quality. Malays near the road to Cameron Highlands pointed out to me two Gigantochloas, one good to eat, one bitter; they differed a little in hair-colour on the sheaths and a little in the shape of the auricles, and I could see no other clear distinction. There has been no systematic selection of the best edible varieties. The one Gigantochloa which is certainly of excellent quality for this purpose is *G. levis,* but this does not seem to be native, nor commonly planted, in Malaya. The propagation of this species would seem to be worth while. I was told in Kedah that the common small form of *G. ligulata* gave good edible shoots, though of course small ones.

### Key to the Malayan species of Gigantochloa

- Blade of middle culm-sheaths spreading or reflexed, not erect
  - Culm-sheath ligule not over 5 mm. tall including fringe (if any)
    - Culms when young covered with white appressed hairs .. .. 1. *G. apus*
    - Culms when young not so covered
      - Big bamboo, culms 10 cm. or more diameter
        - Culms streaked light green and yellowish .. .. 2. *G. maxima* (typical).
        - Culm uniform dark green .. *G. maxima* var. *viridis*
      - Smaller, culms to about 5 cm. diameter
        - Culm-sheath auricles 2 cm. or more in lateral extent, not over 2 mm. high anywhere .. *G. maxima* var. *minor*

Culm-sheath auricles usually shorter in lateral extent and more or less raised at outer ends .. .. 3. *G. hasskarliana*

Culm-sheath ligule more than 5 mm. tall including fringe

Culm-sheath auricles commonly 7 mm. high .. .. .. 4. *G. levis*

Culm-sheath auricles much lower

Culm-sheath ligule with its fringe at least 10 mm. tall; spikelets densely hairy all over

Hairs on culm-sheaths very dark brown .. .. 5. *G. scortechinii* (typical)

Hairs on culm-sheaths nearly white *G. scortechinii* var. *albovestita*

Culm-sheath ligule with its fringe not over 10 mm. tall; spikelets not densely hairy all over

Culm-sheath auricle without bristles; spikelets 20–25 mm. long, lemmas dark-fringed; leaves glabrous beneath .. 3. *G. hasskarliana*

Culm-sheath auricles often with bristles at the outer end; spikelets to 20 mm. long, lemmas brown-fringed; leaves more or less hairy beneath .. 6. *G. wrayi*

Blade of middle culm-sheaths erect

Culm-sheath ligule not over 4 mm. tall

Culm-sheath blade broadly triangular, not narrowed at base .. 7. *G. ridleyi*

Culm-sheath blade narrowly triangular and narrowed at base .. 3. *G. hasskarliana*

Culm-sheath ligule 10–25 mm. tall

Culm-sheath ligule much taller at ends than in middle; leaf-ligule commonly 15–20 mm. tall .. 8. *G. ligulata*

Culm-sheath ligule not taller at ends than in middle; leaf-ligule less than 10 mm. long, usually much less .. 9. *G. latifolia*

1. **G. apus** (Schult.) Kurz in Tijdschr. Ned. Ind. 27: 226. 1864. Munro in Trans. Linn. Soc. 26: 126. 1868. Backer, Handb. Fl. Jav. 2: 275.

Basonym: *Bambusa apus* Schult., Syst. Veg. 7: 1353. 1830.

Synonym: (?): *Gigantochloa kurzii* Gamble in Ann. R. Bot. Gard. Calc. 7: 65, pl. 56. 1896. Parker in Indian Forester 57: 108. (Not *G. kurzii* sensu Ridl., Flora 5: 261.).

*Young culms* covered partly or wholly with fine whitish appressed hairs, thus appearing grey-green, smooth and green when old; culms 10–20 m. tall, up to 9 cm. diameter, basal part unbranched and of even thickness, longest internodes 45 cm. or more long. Middle *culm-sheaths* dark-hairy on the back, commonly 25 cm. long (to 45 cm., fide Backer), middle part of the top (bearing the blade) distinctly rounded, the edge on either side of the blade bordered by narrow firm *auricles* (part near the blade commonly under 2 mm. high, outer ends about 3 mm.) their edges with scattered rather slender bristles; *blade* reflexed, deciduous when old, relatively narrow and narrowed at the base, when young dark-hairy on both surfaces (4·5 to 18 cm. long, 2–6 cm. wide, fide Backer); *ligule* 3–5 mm. high, irregularly toothed, not long-bristly (fig. 28). *Leaf-blades* very variable in size on the same culm or even on the same branchlet, distal ones often much smaller than basal, 9–40 cm. long, 1·5–7·5 cm. wide, paler beneath than above and very finely hairy beneath when young, petiole commonly 7–12 mm. long; auricles firm, rounded, usually quite glabrous; ligule 2–3 mm. tall, edge finely hairy. *Spikelets* 15–20 mm. long, 3·5–4·5 mm. wide near the base; bracts and glumes, of increasing size, 4–5; perfect florets 3 or 4; *lemmas* of perfect florets to 17 mm. long, shortly pointed, fringed near the apex with dark brown hairs, the outer surface bearing short fine appressed hairs near the apex; *paleas* with long hairs on the keels, 4–5 veins between keels and 1–3 between each keel and edge; *anthers* to 8 mm. long, with slender tips; *fruit* 10–12 mm. long.

DISTRIBUTION: probably native in Tenasserim, introduced long ago to Java and widely planted there, little known in Malaya.

This species is well known in Java by the names Bambu (or Pring) Apus and Bambu Tali. The above description (apart from the floral characters, which are taken from Backer) was prepared from a plant near the Javanese gardeners' quarters at the Botanic Gardens, Singapore, said to have been brought from Java (Md. Nur & Pestana, several specimens, S). The only other plants I have seen in Malaya are at the Federal Experimental Plantation

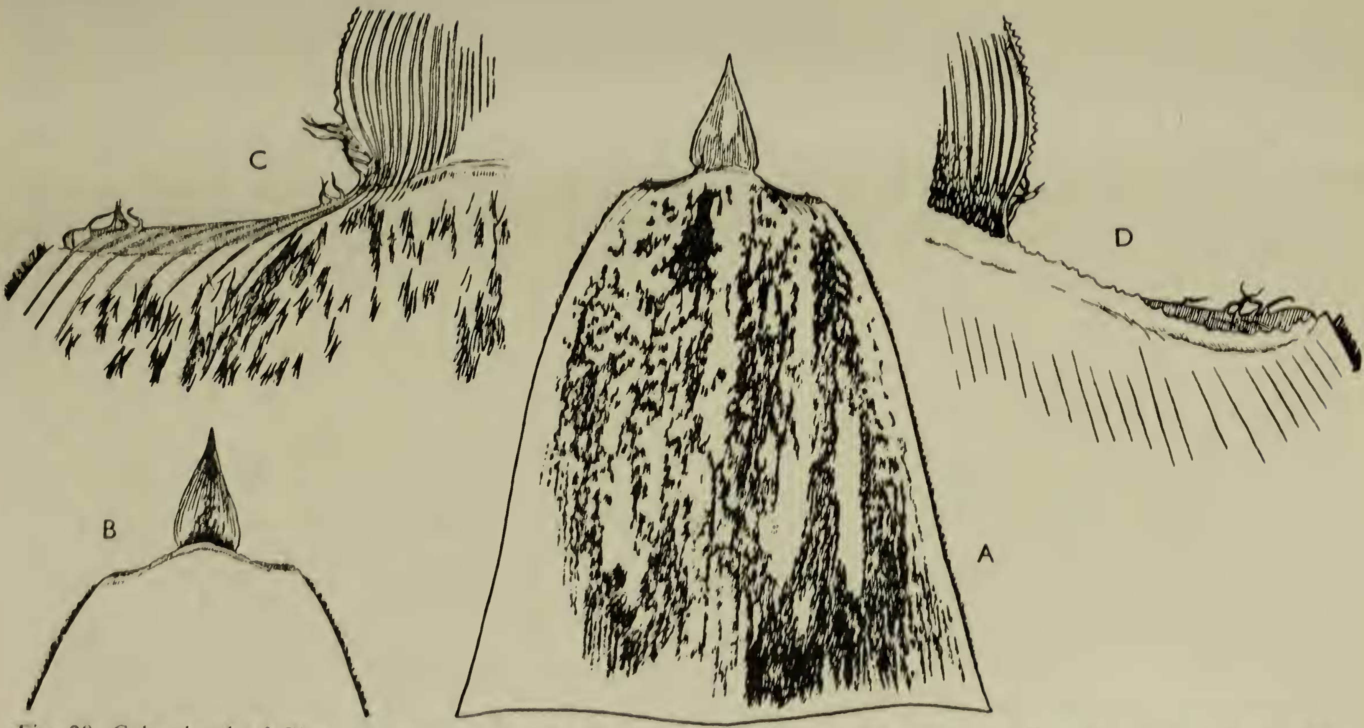

Fig. 28. Culm-sheath of *Gigantochloa apus.* A, outer surface of flattened complete sheath. × ½. B, upper part of inner surface of same, C, outer view of auricle (shaded) and base of blade, × 2. D, inner view corresponding to C, showing ligule and the auricle overtopping it at its outer end,

of the Department of Agriculture, at Serdang, Selangor (Holttum s.n. 21.10.1946, S). It is quite likely that plants exist also elsewhere in Malaya, but they are not common village plants in any places I have visited. As *G. apus* is considered the most useful species in Java, its planting should be encouraged in Malaya.

Schultes's original description is lengthy, but does not mention the vegetative characters which appear to be most distinctive. The association of the name *apus* with the species here described is mainly due to tradition in Java. Young culms of Gigantochloa nearly always have scattered coarse hairs on the exposed parts of the internodes, but I do not know another that has a close cover of pale hairs on the young culms. This covering is quite different from the amorphous white waxy powder often seen on young culms of Dendrocalamus, and also on *Gigantochloa scortechinii.*

The type specimen of *G. kurzii* Gamble was gathered by Kurz in Burma. So far as I can see, there is nothing in it to disagree with *G. apus* as described by Backer, so Backer and Parker may well be right in ranking *G. kurzii* as a synonym of *G. apus*. But the Peninsula specimens quoted by Gamble and Ridley as *G. kurzii* are probably different, and I am placing most of them in *G. wrayi.*

**Uses.** Hildebrand says that this is the most generally useful bamboo in West Java, its poles being especially durable. Heyne states that well matured culms are first dried in the shade and then soaked in water for at least a month, to prevent subsequent attack by beetle larvae. Hildebrand states that small culms are used as a substitute for rotans in making furniture. The name *tali* indicates a use for rope or string. It seems to mean that the culms can be cut up into fine strips for weaving hats and baskets and other objects; when split fine, and the pieces bent, the surface does not chip off. Ochse reports that the young shoots are bitter and not good to eat when freshly cut, but that after immersion in wet mud for 3 or 4 days they are good to eat.

2. **G. maxima** Kurz in Indian Forester 1: 343. 1876.

Synonyms: *G. verticillata* sensu Gamble in Ann. R. Bot. Gard. Calc. 7: 61 (p.p. ?).

*G. verticillata* p.p. sensu Munro in Trans. Linn. Soc. 26: 124; and sensu Backer, Handb. Fl. Jav. 2: 276.

*G. verticillata* var. Awi Gombong, Ochse, Veg. Dutch E. Ind. 323, 325–6.

*Culms* 15 m. or more tall, to 10 cm. or more diameter, rather light green streaked with many longitudinal bands of yellow-green, not hairy. *Culm-sheaths* to 30 cm. long, hairs on back copious, very dark brown, top broad and not raised at attachment of blade; *auricles* to 20 mm. in lateral extent, 2–3 mm. high near outer ends, very firm, not bristly; *blade* deflexed, on a large middle sheath 25 cm. long and 5 cm. wide, narrowed at the base; *ligule* 3 mm. high.

DISTRIBUTION: commonly planted in Java; introduced to the Federal Experiment Station, Department of Agriculture, Serdang; the above description made from the Serdang plants on 21 October, 1946 (specimen in H.S.).

**Var. viridis** Holttum, var. nov.

Culmi magni, virides (non luteo-striati), in juventute pilos conspersos fuscos ferentes; vaginae culmorum eis Awi Gombong similes, differunt auriculis 5 cm. horizontaliter extensis.

*Culms* 10 cm. or more in diameter, uniformly green, upper parts of young internodes bearing scattered dark hairs. *Culm-sheaths* like those described for typical *G. maxima,* orange-flushed towards apex when young; *auricles* extending 5 cm. along top edges of sheath each side of the blade, 3 mm. high. *Leaf-blades* commonly about 25 by 2·5 cm., glabrous. *Spikelets* 16–18 mm. long (when detached), 3–4 mm. wide near base; perfect florets 3; *lemmas* fringed with dark purplish hairs; *paleas* with 3–4 veins between keels and 1–3 between keel and edge, keels fringed and outer surface minutely hairy; *anthers* to 8 mm. long.

TYPE: Kota Tinggi, Johore, Holttum S.F.N. 40201 (S).

The above description was made from a large plant on the stream bank near the Mawai Road (north of the road) about two miles from Kota Tinggi. A number of similar large clumps occur along the banks of the stream, but no other has flowered. The area has long been inhabited, and the bamboos are doubtless planted. I am indebted to Mr. J. A. le Doux for pointing out the plants to me and for observing the flowers. I have seen no other similar bamboos in Malaya except those introduced to Serdang from Java, as above described; the latter differ chiefly in their streaked culms. The Serdang plants were not flowering when I saw them, and it is not certain that their spikelets are exactly like those at Kota Tinggi. Backer, who takes a very broad view of the species *G. verticillata* (see discussion below) gives the spikelet-length as 9–13 mm., and anther-length 4–6 mm. Possibly these spikelets were from one of the smaller varieties of his comprehensive species.

**Var. minor** Holttum, var. nov.

Culmi c. 5 cm. diametro, interdum striati, parietibus crassis.

A small bamboo; culms not over 5 cm. diameter, sometimes streaked with light green, thick-walled; culm-sheaths like those of *G. maxima* but proportionately smaller (fig. 29); flowers not known.

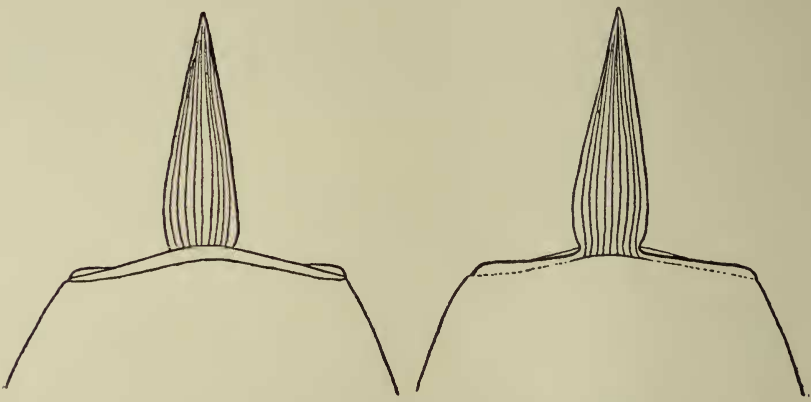

Fig. 29. *Gigantochloa maxima var. minor.* Upper part of culm-sheath with blade raised into the same plane; inner view on left, showing ligule; outer view on right, showing the long low auricles.

TYPE: Forest Research Institute, Kepong, Selangor, Holttum s.n. September 1953 (S).

This is very like a miniature plant of *G. maxima.* It may be the same thing as Kurz's *Bambu Andong ketjeel.* The clump is a large and vigorous one, and I think had reached its full growth as regards size of culms. I have not noticed this bamboo in Malay villages; its origin is not recorded. It is planted near the big clump of *Dendrocalamus giganteus,* and may be another introduction made about the time the Institute was established.

As indicated above, this species has usually been called *G. verticillata,* a name based on *Bambusa verticillata* Willd. (Sp. Pl. 2: 245. 1797). Willdenow's specimen, which he described very briefly, was seen by Munro, who reported that it consisted of a single flowering branchlet, sent by Thunberg from Java; apparently this specimen bore the local name *Tring ater,* but Munro ranked *G. atter* Kurz as a separate species. Munro also included several other specimens under *G. verticillata,* a procedure objected to by Kurz in 1876; Kurz divided Munro's species into two, namely *G. maxima* and *G. robusta,* the former with two varieties. He doubted whether Willdenow's specimen belonged to either species, and so rejected the name *verticillata.* Backer has reverted to Munro's treatment, including all (and *G. atter* Kurz) in one species; unfortunately he does not indicate how to recognize the different varieties or forms so included. Gamble includes as a synonym only *G. maxima* from among Kurz's species, citing Ridley 119 from Singapore (which is *G. levis*) and no other specimens from the Peninsula. Gamble's description is taken partly from Munro, and his drawings were made from Kurz's Java specimens, or copied from drawings made by Kurz; he never saw living plants.

Munro's description naturally omits reference to characters of culms and culm-sheaths. He describes lodicules as present in the florets (3 in the uppermost one, 1 or 2 in the others); but did he copy this from the earlier description of Schultes? Gamble also figures a lodicule as seen in a specimen of Kurz. Backer makes no mention of lodicules in his description of the species, and in his generic description says lodicules are lacking. I have never seen a lodicule in any spikelet I would consider to belong to the genus Gigantochloa. Regarding vegetative characters, Kurz and Backer (the two who both saw living plants in Java) disagree as to the blade of the culm-sheath; Kurz describes it as reflexed, Backer as erect. Kurz's drawing of a culm-sheath (copied both by Gamble and by Koorders) shows low fringed auricles and a low toothed ligule. Backer does not describe the auricles clearly (he says they are small and soon fall off).

In the Botanic Gardens at Bogor I examined plants of most of the various forms included by Backer in *G. verticillata*. Their culm-sheaths and other vegetative characters differed so much that I cannot agree to include all in one species; for example, Awi Andong had large raised and rounded auricles with many curved bristles and almost erect broad blades, and a plant named Awi Leah (I think this should have been Awi Gombong) had long low auricles without bristles and reflexed narrow blades, as in the Serdang plants above described. Backer does not indicate this amount of vegetative difference in his description.

It is at any rate certain that the name *verticillata,* as typified by Willdenow's flowering specimen, cannot be attached with certainty to any one of the forms included in *G. verticillata* by Munro and Backer. I consider therefore that this name should be ignored as a *nomen dubium,* and that a new type for the generic name should be proposed. In view of the descriptions of Kurz and Ochse, and of the traditional use in Java of the name Awi Gombong, I do not doubt that the Serdang plants are *G. maxima* Kurz; the only discrepancy is the fringe of hairs on the auricles shown in Kurz's drawing (as copied by Gamble) and his statement "rigidly fringed at the auricles". I offer no explanation of this discrepancy. Typical *G. maxima* is the largest of the Gigantochloas, and is considered a very valuable bamboo for structural purposes in Java. It would surely be worth planting more widely in Malaya.

3. **G. hasskarliana** (Kurz) Backer ex Heyne, Nutt. Plant. Ned. Ind., ed. 2, 1: 299. 1927. Backer, Handb. Fl. Jav. 2: 277.

Basonym: *Schizostachyum* ? *hasskarlianum* Kurz in Indian Forester 1: 352. 1876.

Synonym: *Oxytenanthera nigrociliata* sensu Munro, p.p., in Trans Linn. Soc. 26: 128. (Not *Bambusa nigrociliata* Buse).

*Culms* to about 5 cm. diameter, 5–6 m. tall, thin-walled, green, with dark hairs near tops of internodes when young. *Culm-sheaths* dark-haired on the back, when young black-ciliate on the edges; *auricles* low, stiff, dark green, entire, 10 mm. or more in lateral extent on large sheaths, the end usually somewhat raised and rounded; *blade* spreading or deflexed, lanceolate, narrowed at the base, hairy on upper surface near base; *ligule* 2–4 mm. high, edge toothed, bearing short bristles on the teeth when young. *Leaf-blades* 15–40 cm. long, 2–4·5 cm. wide, lower surface glabrous, stalk 2–5 mm. long; auricles small, glabrous; ligule short, entire or toothed. *Spikelets* few in each group, 2–2·5 cm. long, slightly flattened near the base and hardly 4 mm. wide, gradually narrowed to the slender apex; glumes and lemmas glabrous except for the fringes of dark hairs 1 mm. long on their edges; *florets* commonly 4–5 including the sterile apical lemma; longest *lemma* 20 mm. long; *paleas* almost as long as lemmas, hardly 2 mm. wide between the keels, keels short-fringed, veins 5 or 6 between the keels and 2 between each keel and edge; *anthers* 7 mm. long, with slender toothed or slightly hairy tips; *fruit* narrow, hairy only at apex.

DISTRIBUTION: originally described from Java, where it is probably not native; formerly planted rather extensively for tall hedges in Singapore (Thomson and Serangoon Roads) and less commonly in Penang; not known elsewhere in Malaya, probably native in Burma.

The above description was made from Singapore plants. Penang plants, both in the Waterfall Garden and at Hutchings School, have somewhat wider and less reflexed blades on the culm-sheaths, and auricles more truly auricular in shape; but the general habit and spikelets are identical. Kurz, in his original description, gives the name Bamboo Lengka Tali; a plant so named at Bogor agrees well with those in Singapore. Backer's description also agrees, except as follows: he says the fringing hairs on the lemmas are yellow-brown, and the anthers 8–10 mm. long (I may not have seen anthers in the longest floret on a spikelet). Munro, under *Oxytenanthera nigrociliata,* cites Wallich 5033 from Burma, which has long slender spikelets very like those of the Singapore plants of *G. hasskarliana;* it is however possible that the vegetative parts of Wallich's plant were different. Kurz and Backer both give descriptions of Java plants of *Gigantochloa nigrociliata* (Buse) Kurz which certainly indicate something different from Wallich's specimen (see Kurz in Journ. As. Soc. Beng. 39 (pt. 2): 88. 1870). *Bambusa nigrociliata* Buse, described from Java, is undoubtedly a Gigantochloa. Munro put it into Oxytenanthera, and many others have copied him, including Gamble and Camus. Ridley used the name *O. nigrociliata* for various different Gigantochloas, rather uncritically.

The name *Bambusa auriculata* Kurz (later transferred to Gigantochloa by Kurz himself, but only on vegetative evidence), given to a bamboo from Burma, needs also to be considered. Gamble's figure of a culm-sheath attributed to this species (his plate 49) resembles considerably the lower sheaths of the Penang plant here included in *G. hasskarliana;* it was from a plant of which Gamble had not seen the flowers, and he retained it in Bambusa. I judge from Kurz's description that *G. auriculata* is a big bamboo, which *G. hasskarliana* is not. Possibly Wallich 5033 represents the flowers of *G. auriculata.*

*Specimens:* SINGAPORE, Thomson Road, Ridley 8063 (S); Burkill s.n. 5.8.1918 (S); Holttum s.n. 13.12.1934 (S). Geylang, in a hedge, Ridley 8087 (S,K). Ang Mo Kio, roadside, Ridley 6682 (S,K). Bedok, Ridley 12198 p.p. (S,K). Government House Domain, Holttum S.F.N. 21163 (S,K); Henderson s.n. September 1933 (S). Kampong Teban, Sinclair S.F.N. 38863 (S). PENANG, Hutchings School, Cheang Kok Choy S.F.N. 37942 (S). Waterfall Garden, Holttum s.n. 24.10.1946 (S).

4. **G. levis** (Blanco) Merr. in Amer. Journ. Bot. 3: 61. 1916. Enum. Philip. Pl. 1: 96 (synonymy).

Basonym: *Bambusa levis* Blanco, Fl. Filip. ed. 1: 272. 1837.

Synonyms: *Gigantochloa scribneriana* Merr. in Philip. Journ. Sci. Suppl. 1: 390. 1906.

*G. verticillata* sensu Ridl., Flora 5: 260.

*G. verticillata* sensu Backer, Handb. Fl. Jav. 2: 276, p.p.

*Culms* to 15 m. or more tall, to about 10 cm. diameter, when young bearing both pale and brownish hairs on upper part of internodes, when old smooth and dark green; internodes to about 45 cm. long; lowest nodes somewhat swollen and root-bearing. Middle *culm-sheaths* to 30 cm. long, densely dark-hairy (hairs loose and spreading) almost all over the back when young, top almost truncate, bearing a raised *auricle* commonly 7 mm. high (to 12 mm.) on each side connected by a narrow rim to the base of the blade, auricles bearing a few marginal bristles 10–15 mm. long; *blade* dark purple on lower sheaths, green on upper ones, reflexed, relatively narrow, narrowed at the base, hairy towards base on upper surface; *ligule* lacerate, undivided part 5–7 mm. high, lacerations with bristle-like tips, ligule with its fringe of bristles 15–20 mm. high (fig. 30). *Leaf-blades* commonly to 30 cm. long and 4 cm. wide, larger on small culms, lower surface finely hairy; sheath-auricles usually distinct, bearing a few bristles to 4 mm. long; ligule shortly toothed. *Spikelets* usually on leafless culms, in groups at the nodes of the branches; groups 1·5 to 12 cm. apart, those on the large branches often of many spikelets, densely spherical, surface of internodes softly short-hairy; mature detached spikelets 10–15 mm. long, 4 mm. wide, somewhat flattened, apex acute; basal empty glumes 2 or 3; *lemmas* 4 or 5, 6–10 mm. long, edges with rather long pale hairs, surface very finely hairy, veins many, with distinct cross-veins, apex shortly pointed; *paleas* narrow, long-hairy on the keels, finely hairy on edges and back, veins between keels 2–4, 1 or 2 veins between each keel and edge; uppermost palea slightly keeled, short-hairy on keels; *anthers* 4–6 mm. long, tip slightly hairy; style hairy throughout, stigma undivided.

DISTRIBUTION: originally described from the Philippines where it is widespread but probably not native; planted also in Borneo (specimens seen at Kew) and Indochina (Camus); in Malaya found as a village bamboo or planted in Singapore, Johore, Malacca and Selangor; produces excellent edible shoots.

RECORDED MALAY NAMES: Buloh Bisa (doubtful); Buloh Suluk (N. Borneo).

Merrill's description of his *G. scribneriana* agrees in spikelet characters with Malayan specimens except that he describes the anthers as 7–8 mm. long; he does not describe the culm-sheaths. He states that the species is "usually if not always planted", and no other Gigantochloa is known from the Philippines (also that no other Philippine bamboo corresponds to Blanco's description). In the Kew herbarium good culm-sheaths of the following Philippine collections agree well with those seen in Malaya: Luzon, Prov. Bulacan, Bur. Sci. no. 11838 (C. B. Robinson); Leyte, Prov. Visayao, G. M. Weber 1527.

I judge that this Gigantochloa would be regarded by Backer as a variety of *G. verticillata.* As Ochse (Veg. Dutch E. Ind. p. 317) states that *G. atter* produces young shoots which are among the best for eating, this seems the most likely among the species included in *G. verticillata* by Backer, but Ochse's accompanying

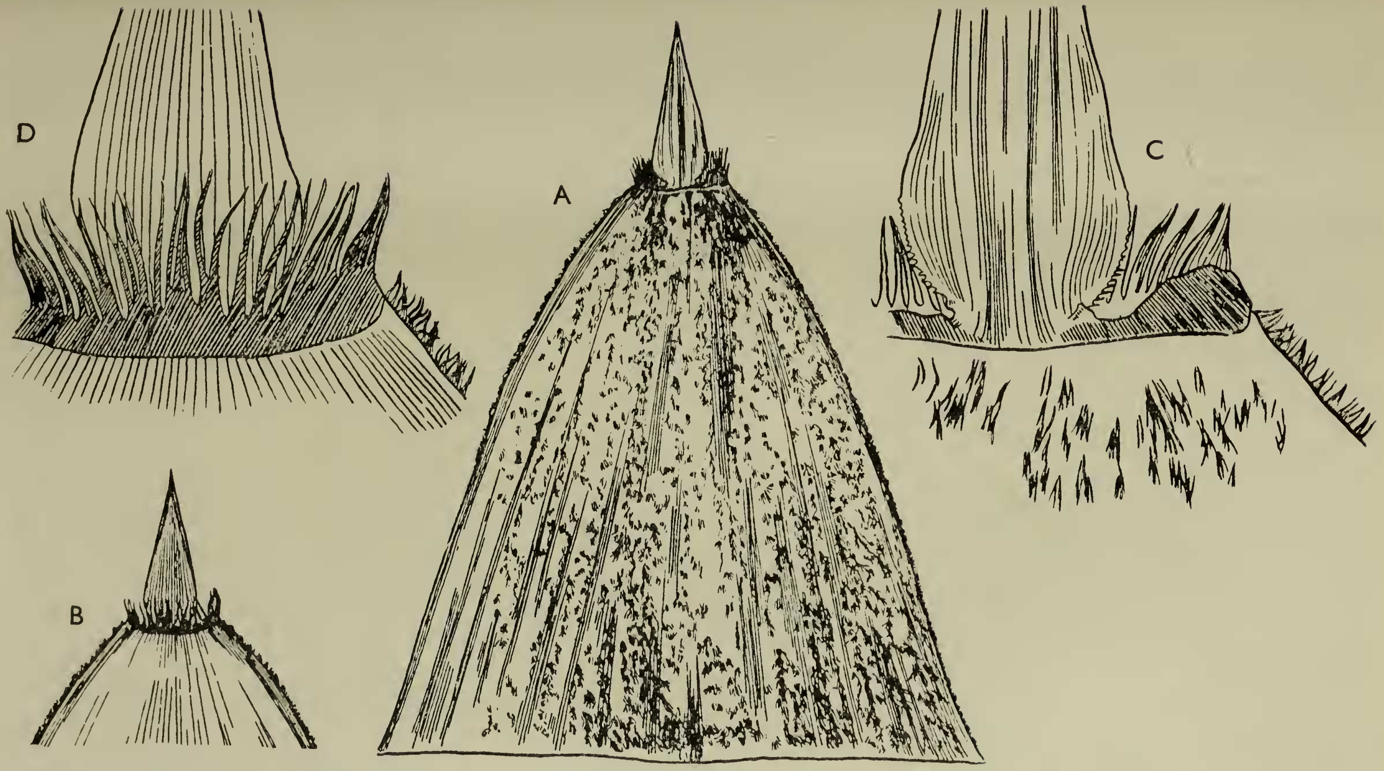

Fig. 30. Culm-sheath of *Gigantochloa levis*. A, outer surface of flattened complete sheath, × 1/3. B, inner surface of top of sheath and blade. C, outer surface of part of top of sheath, showing an auricle (obliquely shaded) and the deeply incised ligule behind it, × 3/2 (bristles on auricle omitted). D, inner surface of top of sheath, showing the whole ligule and base of blade.

description only describes the sheaths of the shoots as cut for eating, and these do not show the distinctive characters of sheaths on actively growing young culms. The figure of *G. atter* given by Koorders (Exkurs. Fl. 4, fig. 171) shows a culm-sheath with appropriately large auricles but a tall ligule which is not long-fringed. My observation of Bamboo Ater at Bogor agrees with Koorders' drawing and I saw nothing at Bogor quite like the Malayan plants here described. Kurz's description of *G. atter* also differs from my observations of *G. levis*. It is possible therefore that *G. levis* is not in Java. It may be a Gigantochloa selected originally in Burma and carried along a different stream of human migration; to the Philippines via North Borneo ? or to North Borneo from the Philippines and so to Singapore ? .

I have not noted this as a common species in Malaya; it is certainly not common in Singapore. Ridley notes on his specimen no. 119 "this is the common campong (i.e., village) bamboo", but I doubt is he was right. (Gamble thought Ridley intended the word campong as the name of the bamboo). A plant was brought to the Botanic Gardens, Singapore, many years ago by Ridley, its source unrecorded. This plant never grew to a large size, because it was well known as a source of good edible shoots, until special arrangements were made to protect it.

This species shows some resemblances to *Dendrocalamus asper* in general habit and in appearance of spikelets, and both yield excellent edible shoots. The differences are as follows: bases of culms in *G. levis* are not persistently brown-hairy, upper culm-sheaths of *G. levis* have dark hairs, the auricles are not crisped and have longer bristles, the ligule has a long fringe of bristles (a much shorter one of fine hairs in *D. asper*), and spikelets are longer with longer fringes on the lemmas.

*Specimens:* SINGAPORE, Bamboo no. 48, cult. H.B.S., and others propagated from it (origin unrecorded), J. L. Pestana s.n. 26.8.1937 (S,K). Tivoli, Ridley 119 (S). Pasir Panjang 6½ mile, Holttum s.n. 9.12.1934 (S). JOHORE, Kota Tinggi, le Doux s.n. 5 November, 1948 (S). MALACCA, Maingay 1730 (K). SELANGOR, Salak South, 5th mile from Kuala Lumpur, Jagoe S.F.N. 37932 (S). Kepong, cult., Symington F.D. 23138 (S, Kep.).

5. **G. scortechinii** Gamble in Ann. R. Bot. Gard. Calc. 7: 62, pl. 53. 1896. Ridl., Flora 5: 261.

*Culms* 10–20 m. tall, to 12 cm. diameter, close, straight, covered with a fine white waxy powder when young, green when old, internodes to about 40 cm. long. *Culm-sheaths* light orange at the top when young, rest covered with appressed coarse nearly black hairs, similar hairs fringing edge of sheath; *blade* much narrower than top of sheath, reflexed at right angles, green (except on lowest sheaths) and leaf-like, at 200 cm. from the ground nearly as long as the sheath, base somewhat constricted and then spreading to a dark green narrow rim (*auricle*) along the top of the sheath, ends of the rim hardly raised, sometimes with a few stiff pale bristles; *ligule* deeply incised, the lobes produced into bristles, the whole to 10 mm. tall or at the ends to 18 mm. *Branches* few at each node but foliage dense; *leaf-blades* to 35 by 5 cm., lower surface softly hairy throughout (hairs 0·5 mm. or more long), stalk 2–4 mm. long; auricles small, usually with a few bristles; ligule short, sometimes bearing bristles. *Spikelets* usually on slender leafless branches (often a whole culm flowers without any leaves) in groups up to 5 cm. apart; mature spikelets 18–20 mm. long, distinctly flattened and widest near base, 6 mm. wide, all glumes and lemmas densely brown-hairy on the surface and brown-fringed on the edges; *perfect flowers* 4 or 5; *lemmas* 12–16 mm. long; *paleas* about 2 mm. wide between the keels, keels fringed, veins between keels 5 or 6, and one between each keel and edge; *anthers* to 9 mm. long.

DISTRIBUTION: Malaya, from Tampin northwards, one of the commonest bamboos in the foothills of the Main Range.

RECORDED MALAY NAMES: Buloh Sĕmantan, Buloh Tĕlor, Buloh Rayah, Buloh Pa-aao, Buloh Gala; Buloh Sĕrĕmai (var. *albovestita*).

I have several times seen whole culms of this bamboo flowering, the remaining culms on the same clump leafy, and I have never seen a gregarious flowering of all plants in one district. The broad and very hairy spikelets are characteristic; the culm-sheaths not so clearly different from what I am calling *G. wrayi.* The leaves are very like those of other species of Gigantochloa, and there is some variation in hairiness.

There appear to be two slightly differing varieties of this species in Selangor, both seen near together at Rawang; further study may reveal more and different variation. One of the two varieties has strongly orange-coloured young culm-sheaths and a white waxy covering of the young culms; this has been clearly associated with typical spikelets of *G. scortechinii.* The other form has less orange colour in the young sheaths, and the upper parts of the internodes of the young culms have little waxiness but carry a few pale and brown hairs.

*Specimens:* NEGRI SEMBILAN, Kangkoi, F.Gd. Hussein F.D. 9596 (S); Buyong F.D. 11005 (K). Jelebu, Kinsey s.n. (K). SELANGOR, Bukit Hitam, Ridley 7786 (S,K). Gua Batu, Ridley 8170 (S,K). 15th mile Pahang Track, Ridley 8481, 8483 (S,K). Klang Gates, Ridley s.n. 1.1.1921 (K). Ulu Gombak, Foxworthy F.D. 6429 (S). Gombak Reserve, Strugnell F.D. 10549 (K). Salak South, Kuala Lumpur, F.Gd. Md. Soh F.D. 13820 (S, Kep.) 43rd mile Gap Road, Wyatt-Smith F.D. 76168, 76169 (Kep.). Near Rawang, Holttum S.F.N. 37789 (S). Ginting Simpah Road, Holttum S.F.N. 38415 (S). Gunong Semangkok, Gap, 2,000 ft., Curtis 3746 (S,K). Near Rawang, Holttum s.n. October 1946 (S). Ulu Kerling & Ulu Selangore, Kunstler 8572 (K). PERAK, without locality, Scortechini (K, type). Temengoh, Ridley 14383 (S). Behrang F.R., C. Smith F.D. 1160 (S). Grik, F.R. Hamid F.D. 6419 (S), F.D. 8253 (S,K). Near Grik, Burkill & Haniff S.F.N. 12479 (S,K). Jor, Burkill & Haniff S.F.N. 14238 (S). Upper Perak, Wray 3433 (S,K). PAHANG, Kuala Lipis, Somerville F.D. 10488 (K), F.D. 10490 (K); Marshall F.D. 21385 (Kep.). Ulu Chineras, Burkill & Haniff S.F.N. 15690 (S). Bentong, Burkill & Haniff S.F.N. 16417 (S), S.F.N. 16435 (S). Near Raub, Burkill & Haniff S.F.N. 16855 (S). Ulu Kuantan, Craddock s.n. 4.3.1903 (S). PENANG, Cult. Waterfall Garden, Curtis 10849 (S,K); Pestana s.n., April 1934 (S,K). KEDAH, Ulu Pantai Mulik, Sow F.D. 34625 (Kep.). Kampong Naka, Holttum S.F.N. 19826 (S). KELANTAN, Tanjong Telok Lalu, Haniff & Nur S.F.N. 10206 (S,K). Sungei Betis, Henderson S.F.N. 29704 (S,K).

**Var. albovestita** Holttum, var. nov.

Vaginae culmorum extus pilis albis vestitae; internodia culmorum apicem versus pilis albis rigidis instructa.

Culms slender (2·5–3·5 cm. diameter); leaves on smaller branchlets 12–18 cm. long, 10–15 mm. wide, on larger ones to 25 cm. long and 20–26 mm. wide; culm-sheath ligule 13–15 mm. tall at ends, often lower in the middle, cut almost to the base throughout, auricles low, firm, not bristly; no flowers.

TYPE: Kedah, 9th mile from Alor Star to Pokok Sena, Holttum, K 11, December 1953 (S).

Specimens from Grik probably also belong here. These have culms 7 cm. diameter, and white-hairy sheaths. The ligules on the sheaths are broken so much that their original height cannot be judged. The specimens are: Grik, F. R. Hamid, F.D. 6425 (S), 8252 (S,K).

6. **G. wrayi** Gamble in Ann. R. Bot. Gard. Calc. 7: 64, pl. 55 (as regards flowering specimens only). 1896. Ridl., Flora 5: 261.

Synonym: *G. kurzii* Gamble l.c. 65, as regards specimens from Malaya.

*Culms* 2–7 cm. diameter, not hairy, walls of moderate thickness. *Culm-sheaths* to at least 27 cm. long, dark-hairy when young, line of junction with blade nearly horizontal; *auricles* firm, low, raised near the outer ends, often bearing a few bristles near the outer ends, edge otherwise smooth; *blade* reflexed, green when young, relatively narrow and narrowed at the base, of middle sheaths about 12 by 3·5 cm., of upper sheaths to 22 by 4 cm. or longer, dark-hairy on upper surface; *ligule* deeply incised throughout, the lobes prolonged into bristles, the whole (including bristles) 6–10 mm. high (fig. 31). *Leaf-blades* 9–40 cm. long, 1·2–6 cm. wide, lower surface finely hairy, stalk to about 8 mm. long; auricles small, often with bristles; ligule short, edge irregularly toothed but usually not bristly. *Spikelets* to about 2 cm. long and 5 mm. wide, with 3 or 4 perfect florets (fig. 27); *lemmas* to 17 mm. long, with a short stiff apex, edges fringed with brown hairs 1 mm. long, exposed parts of the surface very finely short-hairy; *paleas* fringed on the keels (fringe sometimes near apex only); *anthers* to 8 mm. long; *ovary* hairy at apex only, style long, stigma undivided; *fruit* about 10 mm. long.

DISTRIBUTION: as here interpreted (not with certainty; see discussion below) native in the northern part of Malaya, and probably planted in villages; probably native also in the region north of Malaya.

RECORDED MALAY NAMES: Buloh Bĕti, Buloh Mata Rusa, Buloh Manis, Buloh Semantan, Buloh Minyak.

Gamble's type specimens (Wray 1895 from Bukit Gantang, Perak) are mounted on two sheets, on one a leafy branch, on one a flowering branch. The leafy branch is to me indistinguishable from *Schizostachyum brachycladum*, the shape of the well-developed leaf-auricles being very distinctive and unlike anything I have seen in Gigantochloa. The Malay name recorded with the specimen is Buloh Plang, commonly used for *Schizostachyum*. I consider therefore that the species should be typified by the flowering branch only; but spikelets alone are not very satisfactory for characterizing a species in this genus. As regards Gamble's description of the spikelets, he makes the statement that the keels of the palea are "not or only very faintly ciliate". I examined a spikelet from the Calcutta sheet of the type collection (kindly sent to me in Singapore by Dr. K. Biswas) and found that the paleas had quite normal long fringes; a spikelet from the Kew sheet (from Gamble's own herbarium) had keels rather sparsely ciliate, towards the apex only. The hairiness of the keels thus seems variable, and I do not think it has any diagnostic value. The Singapore specimen has no spikelets.

Gamble identified no other specimen as *G. wrayi*. I have however included here, with some doubt, the specimens from Malaya called *G. kurzii* by Gamble and Ridley, and some others. They have on the whole somewhat larger spikelets than those of the type of *G. wrayi* and the lemmas have usually fringes of a lighter brown. These specimens are vegetatively difficult to separate clearly from *G. scortechinii;* their spikelets, where known, are smaller and much less hairy than those of *G. scortechinii*. There is need for a more careful survey of Gigantochloas in the north of Malaya in order to distinguish this species (or species-group) more clearly. It may be that the extreme forms of *G. scortechinii* and *G. wrayi* are connected by a number of intermediate heterozygous forms.

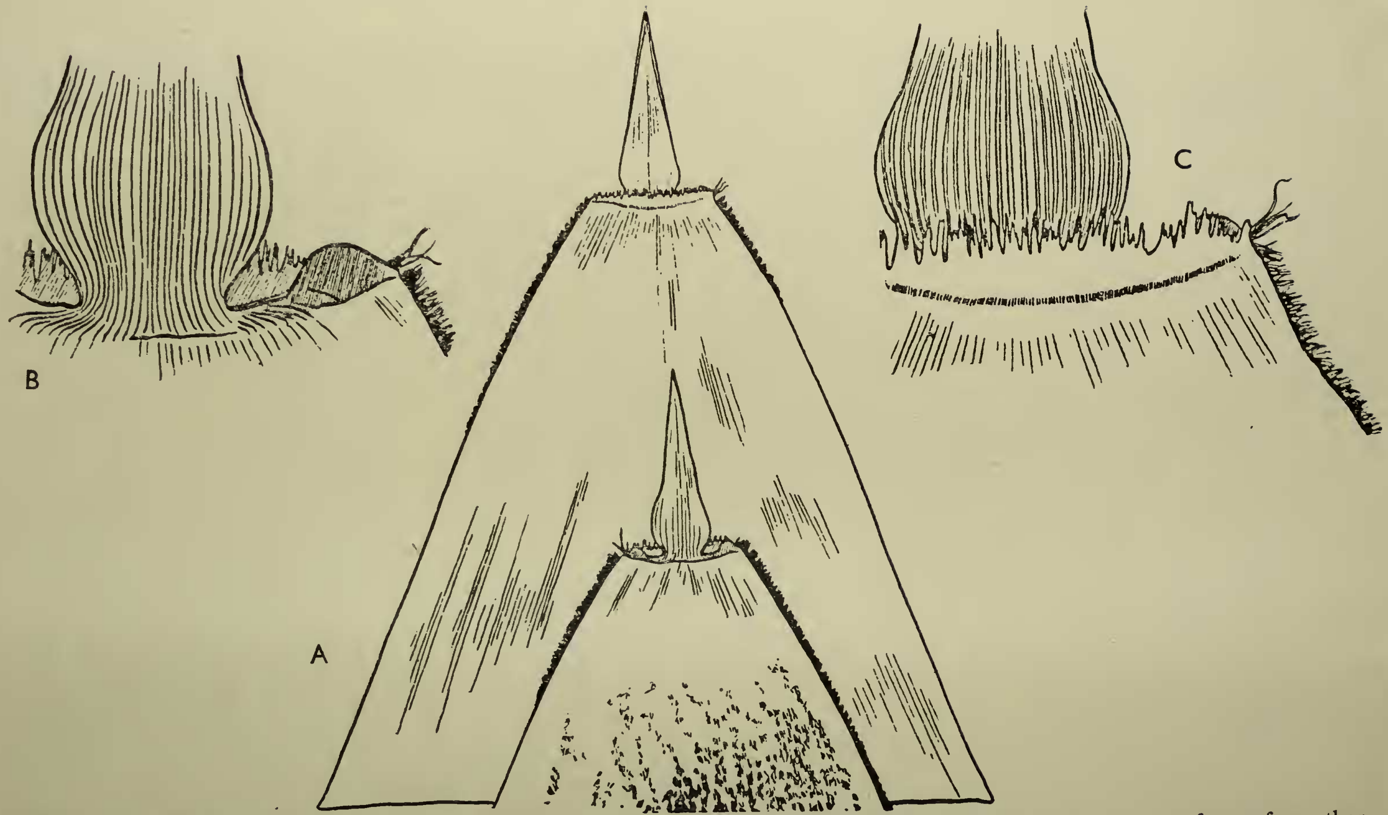

Fig. 31. Culm-sheath of *Gigantochloa wrayi*. A, inner surface of whole flattened sheath, with outer surface of another sheath superimposed, × ½. B, outer surface of part of top of sheath, showing an auricle (closely shaded) base of blade, and part of the ligule, × 2. C, inner surface of part of top of sheath, showing ligule and base of blade.

The type of *G. kurzii* Gamble came from Burma. Parker suggested that it was not different from *G. apus*. Gamble later agreed with this suggestion (as evidenced by a note in his copy of the monograph), and Backer has united *G. kurzii* and *G. apus*. There is no doubt that the Peninsula specimens called *G. kurzii* by Gamble are not *G. apus,* which is separately described in the present work.

*Specimens:* SINGAPORE, Lower Garden, Ridley 12501 (S,K). Garden Road near Office, Ridley s.n. 1903 and 27.4.1908 (S). Cluny Road near Gardens Office, Pestana s.n. 9.9.1937 (S,K). SELANGOR, Kanching F.R., Abd. Rahman F.D. 37600 (Kep.). PERAK, Bukit Gantang, Wray 1895 (the flowers only; type of the species, S,K). Lumut, Ridley 3114 (S,K). Grik, F.R. Hamid F.D. 6420 (S,K), F.D. 8254 (S,K). Taiping, Burkill & Haniff S.F.N. 13118 (S,K); Wray 134 (S,K). Tapah, Pahang Road 10th mile, Burkill & Haniff S.F.N. 13452 (S,K); Holttum S.F.N. 38420 (S); 4½ mile, Holttum S.F.N. 38426 (S). South of Lahat, Burkill & Haniff S.F.N. 13920 (S,K). Kuala Kangsar, Haniff S.F.N. 14921 (S). Changkat Jong, Holttum S.F.N. 38431 (S). Batu Gajah, Barnard s.n. August 1915 (S,K). Tapah, Curtis s.n. October 1894 (S). PROVINCE WELLESLEY, Permatang Bertam, Ridley 6999 (S,K). PENANG, Balik Pulau, Cheang Kok Choy S.F.N. 37941 (S). KEDAH, Bukit Jamboi, Holttum S.F.N. 19819 (S). LOWER SIAM, Kopah, Haniff 12608 (S). Kasoom, Curtis 3237 (S).

**G. wrayi** Gamble, **large variety** ?

Near the road to Cameron Highlands, at Jor (1,500 ft.) I was shown a large Gigantochloa (culms 10–12 cm. diameter) with culm-sheaths corresponding to the above description of *G. wrayi* (a description made from Singapore plants). The Jor plant had no flowers. The local Malays gave the name Buloh Pĕrim to this bamboo, and said it was the best kind for making baskets (i.e., good pliable strips could be obtained by first radial and then tangential splitting).

*Specimens:* Jor, Holttum S.F.N. 38423 (S). Third mile from Tapah, in a Malay compound, Holttum S.F.N. 38424 (S). (Latter plant had no good sheaths).

7. **G. ridleyi** Holttum in Gard. Bull. Singap. 15: 275. 1956.

*Culms* to about 16 m. tall, and to 10 cm. diameter; internodes glabrous, green. *Culm-sheaths* long-persistent, to 25 cm. long, the back covered with almost black appressed hairs, the top united to the blade without any external line of separation; *blade* not deciduous, erect, when young appressed to the culm, triangular, line of junction with the sheath (as shown by ligule) upcurved, blade of a middle sheath 8–10 cm. long, 6 cm. wide, not narrowed at the base but decurrent along the top of the sheath as a low rigid *auricle* on each side, the edge of the blade near its base, and adjacent parts of the auricles, bearing short curved bristles; *ligule* to 3 mm. high, almost entire, the edge somewhat undulate and slightly toothed, not bristly (fig. 32). *Leaf-blades* to 40 cm. long and 6 cm. wide, glabrous on the lower surface apart from a few hairs near the midrib, stalks of lower leaves 4–5 mm. long, of upper leaves 10 mm. long; young sheaths hairy, auricles small and glabrous, ligule low and entire.

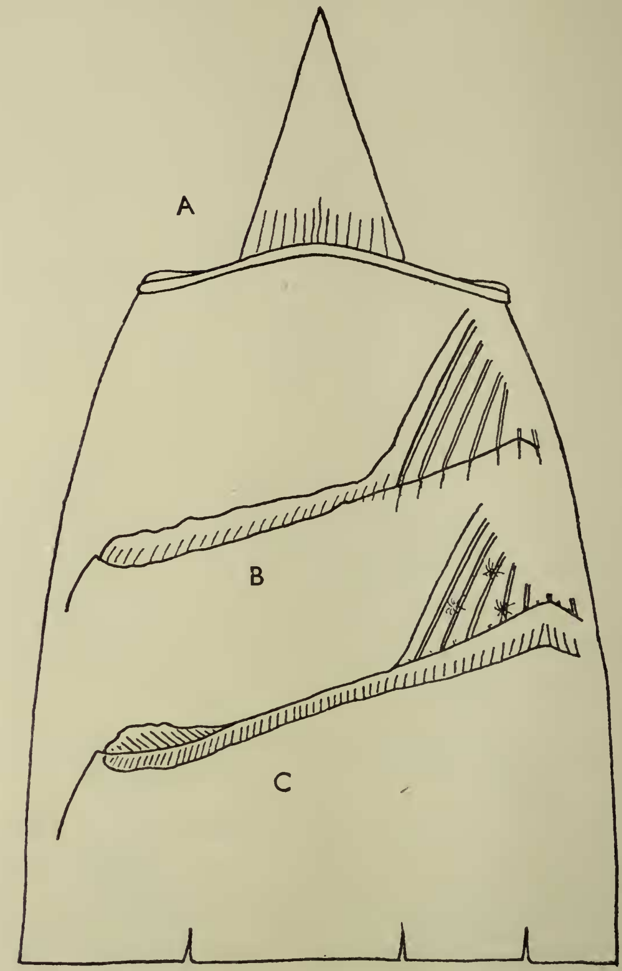

Fig. 32. Culm-sheath of *Gigantochloa ridleyi.* A, inner surface of whole flattened sheath, showing complete ligule with the ends of the auricles rising above it. B, outer view of half of top of sheath, showing relation of the low auricle to the base of the blade. C, inner view corresponding to B, showing ligule and part of base of blade.

TYPE: cultivated in Botanic Gardens, Singapore, lawn W, origin Province Wellesley; specimens coll. J. L. Pestana in herbaria at Singapore and Kew.

The plant from which the type specimen was taken was brought by Ridley from Province Wellesley to Singapore, at a date not recorded (Ridley s.n., S). The Singapore plant now forms a large clump, and in more than 40 years has not been known to flower. The auricles and ligule of the culm-sheaths are very like those of *G. maxima,* for which reason I have no doubt of the genus; but I have never seen another Gigantochloa with the peculiar broadly triangular, erect, persistent culm-sheath blades, nor have I seen such described. The original plant in Province Wellesley was in a village, not wild, and probably came from further north. I once saw a plant near Kota Tinggi, Johore, very similar to the type of *G. ridleyi,* but took no specimen.

The young shoots of this bamboo are astringent, not good to eat. The culms are strong and quite large, and would probably serve the same purposes as those of *G. maxima.*

8. **G. ligulata** Gamble in Ann. R. Bot. Gard. Calc. 7: 67. pl. 58. 1896. Ridl., Flora 5: 262.

*Culms* 6–9 m. tall, to 4 cm. diameter, walls usually about 10 mm. thick; internodes to 37 cm. long, sometimes slightly streaked with paler green; upper part of young internodes bearing scattered stout very dark brown hairs nearly 1 mm. long, and very fine white hairs 0·2 mm. long; branches from middle nodes few, none from upper nodes. *Culm-sheaths* 14–22 cm. long, rather thin, hairs very dark brown, not very copious and quite deciduous from old sheaths; top of sheath upcurved at attachment to blade but line of attachment not clearly marked externally and blade not deciduous; *auricles* more or less down-curved on the edges of the top of the sheath on each side of the base of the blade, forming low firm smooth rims 1 mm. high and 1·5 to 2·5 cm. in lateral extent, quite lacking bristles; *ligule* 5–6 (–10) mm. high in the middle, 20 mm. high at the ends, incised 4/5 of its width throughout, the middle incisions closest; *blade* erect, commonly 4–4·5 cm. wide, on a middle sheath 10 cm. long, on higher sheaths to 18 cm. or more long, thin, hardly hairy on inner surface, base narrowed a little and then decurrent into the auricles (fig. 33c). *Leaf-blades* on flowering stems to 27 cm. long, 3·7–6 cm. wide, glabrous or very short-hairy beneath, base of lower leaves broadly cuneate, of upper ones narrowly cuneate, petiole about 3 mm. long; half of *callus* below attachment of blade of upper leaves produced into a thin blade 4–16 mm. long; auricles hardly more than raised lines, upcurved along the line on which the top of the sheath meets the ligule; ligule thin, varying in height, highest in the upper (distal) leaves on a branchlet and then 2–3 cm. long, deeply bilobed; leaves on sucker shoots to 10 cm. wide, ligule to 4 cm. high, callus-lobe to 2 cm. long. *Flowering branches* drooping, 80 cm. or more long, little or not branched; nodes bearing spikelet-groups at base 4–5 cm. apart, near tips of branches 1 cm. apart, each group at first enclosed by a sheath 15 mm. long; *mature spikelets* 12–15 mm. long when detached, *lemmas* fringed with dark hairs (old ones may fade to a lighter colour), perfect flowers 2–4; *paleas* fringed on the keels towards the apex, veins between keels 2–5, between each keel and edge 1–2; *anthers* 6–8 mm. long.

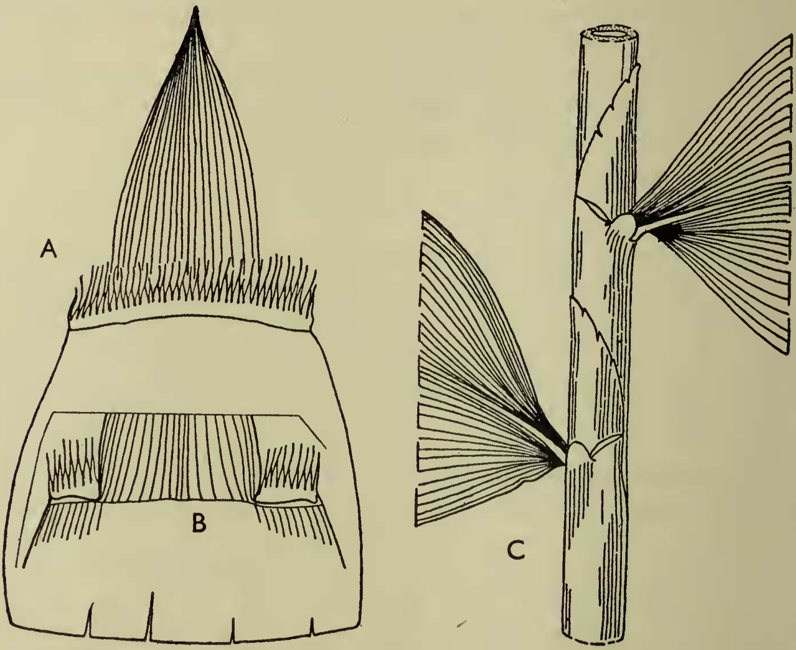

Fig. 33. *Gigantochloa latifolia.* A, complete flattened culm-sheath, inner surface, showing the tall deeply incised ligule. B, top of outer surface of culm-sheath, showing the low auricles with the ligule rising above them. C, *G. ligulata,* part of a leafy branchlet, showing bases of two leaves with their very long ligules, a callus at the base of each leaf, and a narrow auricle rising from behind each callus to join the side of the ligule.

DISTRIBUTION: northern part of Malaya; southern Siam.

RECORDED MALAY NAMES: Buloh Tikus, Buloh Tilan (Pahang).

This species was originally described from two flowering specimens, one from Perak (Wray 845) and the other from Pahang (Kuala Tahan, Ridley 5597), the latter in poor condition. These specimens lack culm-sheaths, in which I find much variation in Kedah, and the enlarged callus below a leaf-stalk is only 2–3 mm.

long. The description given above is based on specimens gathered by me from open country near Alor Star, Kedah, where the species is abundant. I suggest that this should rank as the typical form of the species; as so interpreted, it is a smallish, thick-walled bamboo. The young shoots, though small, are said to be of good edible quality. In bamboo thickets in northern Kedah there are larger bamboos with similar ligules of culm-sheaths and leaves, somewhat variable in detail, as described below; and similar bamboos occur in Perak near the road to Cameron Highlands, so that they are probably abundant in northern Malaya generally.

**G. ligulata, larger varieties.**

Culms 5–6 cm. diameter (to 8 cm. ?); sheaths to 30 cm. or more long, more rigid than in the typical form, junction between blade and sheath ultimately distinct; culm-sheath ligule always c. 2 cm. high at ends, lower in the middle, the ends in some cases entire, in some cases lacerate, the middle part always in some degree lacerate, sometimes deeply so; half of callus of upper leaves on each branchlet often elongate and membranous, variable on the same plant.

Recorded Malay names: Buloh Bilalai, Buloh Gala, Buloh Mata Rusa, Buloh Bĕlang, Buloh Hitam, Buloh Mĕliau.

The following key is an attempt to indicate the nature of the variation observed among specimens of the larger varieties of *G. ligulata*. The numbers prefixed by the letter K refer to specimens collected by me in northern Kedah in 1953; letters A–D refer to previous collections from the same area.

| | |
|---|---|
| Culm-sheath auricles bearing long bristles (2 cm.) | |
| Leaf-blades glabrous beneath; about 40 bristles on each auricle . . . . | K2 |
| Leaf-blades very short-hairy beneath; bristles on auricles fewer . . . . | K3; C |
| Leaf-blades very short-hairy beneath; bristles on auricles many; lemmas not fringed, or with few pale hairs . . . . | K7 |
| Culm-sheath auricles without bristles | |
| Leaf-blades glabrous beneath . . . . | A; S.F.N. 38430, 38422, 38429, 38421 |
| Leaf-blades short-hairy beneath . . | B; S.F.N. 38417. |

Apart from the vegetative variation, there appears to be variation in the spikelets, smaller spikelets having only 2 perfect flowers, larger ones 3 or 4; how far there may be such variation on one plant is not known. Lemmas are normally dark-fringed, but K7 has lemmas almost or quite lacking a fringe, and short pale anthers (5 mm. long). The other specimens with bristly culm-sheath auricles lack flowers; if it should be shown that all such plants have glabrous lemmas and small anthers, they might constitute a new species, but such an association of characters cannot be assumed from one specimen. Another specimen (D) found on a previous occasion in N. Kedah had similar spikelets, but the leaves had ligules only 2 mm. high; the culm-sheaths were very imperfect.

I am not sure that a sharp distinction between *G. ligulata* and *G. latifolia* can be maintained. The present distinction is on length of leaf-ligule and relative width of culm-sheath blades, but in both of these there is much variation, even on the same plant. Perhaps all the bamboos here included under *G. ligulata* and *G. latifolia* constitute an inter-breeding complex of hybrids. Certainly some seeds are formed by these bamboos in Kedah, and the plants do not die after flowering.

*Specimens of small form of species or size unrecorded:* SELANGOR, Kuala Lumpur, per A. Arber (K). PERAK, Tapah, Ridley 14034 (S,K). Sungei Siput, F.Gd. Suleiman F.D. 8325 (Kep.). Cameron Highlands Rd. 10th mile, Holttum S.F.N. 38428 (S). Ipoh, Curtis 3180 (S). G. Kerbau, Haniff 3991 (S). Kuala Wok, Wray 845 (K). PAHANG, Kuala Tahan, Ridley 5597 (S,K). Endau Rompin, Mahamud F.D. 15537 (S). KELANTAN, Sungei Keteh, Md. Nur S.F.N. 11951 (S,K). KEDAH, Tangga Reserve, Dolman F.D. 21544 (S). Bukit Tangga, Symington F.D. 46968 (Kep.). North of Changlon, Symington F.D. 56959 (Kep.). Nerang Rd. 18th mile, Burkill & Haniff S.F.N. 13319 (S,K). Langkawi, G. Raya, Corner & Nauen s.n. 21.11.1941 (S). Sintok Rd., Holttum s.n. 26.10.1946 (S). PERLIS, Near Kangar, Ridley s.n. March 1910 (S); Henderson S.F.N. 22999 (S). Rinta Mas F.R., Symington F.D. 57000 (Kep.). SETUL, Ridley 14837 (S,K). LOWER SIAM, Haniff & Nur S.F.N. 2939, 3887 (S).

*Larger varieties:* PERAK, Grik, Hamid F.D. 6424 (S), F.D. 8256 (S,K). Cameron Highlands Rd. 2,500–3,000 ft. Holttum S.F.N. 38417 (S); do., 15th mile, Holttum S.F.N. 38421 (S), 38422 (S); 11th mile, Holttum S.F.N. 38429 (S); 14th mile, Holttum S.F.N. 38430 (S). KEDAH, Sintok Road, Holttum s.n. (A), (B) and (C) 26.10.46 (all S). North Kedah, Holttum K2, K3, K7 (December 1953, S,K).

9. **G. latifolia** Ridl., Flora Mal. Penin. 5: 262. 1925.

Closely related to *G. ligulata,* differing as follows: culm-sheath blades proportionately wider (on an eye-level sheath of a large culm 15 by 8·5 cm., on a smaller plant 9 by 4 cm.); ligule of culm-sheath not taller at the ends than in the middle, 15 mm. tall throughout on a large sheath, 7 mm. on a small one, incised 1/3 to 1/2 way towards the base in the middle and more deeply towards the ends; leaf ligule commonly 3–4 mm. high, sometimes to 8 mm., sometimes with a few fine bristles on its edge; callus on back of leaf-sheath not produced to form a membranous wing; leaf-sheath auricles occasionally with small bristles; leaf-blades usually in part very short-hairy beneath and slightly glaucous beneath when dry; spikelets 2–4-flowered, lemmas fringed with pale hairs (fig. 33 A, B).

DISTRIBUTION: northern Malaya.

The type of this species was collected at Kuala Teku, Pahang, by Seimund (no. 368, at Kew only). Ridley stated that the spikelets contained only one flower, but I have found two in a spikelet from the type specimen. The type has no culm-sheaths, and I am therefore not certain that specimens from Kedah are the same species; the above description of culm-sheaths is taken from several Kedah specimens, and seems uniform.

This species can grow to a fairly large size, similar to that of the large varieties of *G. ligulata;* I have seen culms about 8 cm. diameter, with walls 14 mm. thick. The young internodes bear stout dark hairs where exposed just below the nodes. The culm-sheath auricles are not bristly; they form firm smooth rims 2–3 mm. high along the top of the sheath each side of the blade.

*Specimens:* PAHANG, Sungei Tahan, Holttum S.F.N. 20075 (S). S. Tahan, Kuala Teku, Seimund 368 (K, type), 227 (S). Fraser's Hill, 4,000 ft., Holttum S.F.N. 39460 (S). PERAK, Tapah, Ridley 14035 (S,K). KEDAH, Alor Star, Ridley 14838 (S,K). Kedah Peak 200 ft., Haniff & Nur S.F.N. 5153 (S). Langgar, Burkill & Haniff S.F.N. 13311 (S,K). Bukit Jamboi 700 ft., Holttum S.F.N. 19818 (S). Sintok Road, Holttum s.n. (D) 26.10.1946; K4, K5 (28.12.1953; S,K).

**Var. efimbriata** Holttum, **var. nov.**

Lemmata non fimbriata, fere glabra; laminae foliorum infra breviter pilosae.

SINGAPORE, Ridley 12198, p.p. (S,K).

**Var. alba,** Holttum, **var. nov.**

Pili vaginarum et internodiorum culmorum albi; laminae vaginarum culmorum supra prope basin dense albo-pilosae.

KEDAH, Langgar, in village by river, Holttum K12, December 1953 (K). Local name: Buloh Pahit (young shoots bitter).

The culms of this bamboo were 5·5 cm. diameter, walls 10 mm. thick; a sheath from a low node on the culm was 20 cm. tall, with blade 7 by 3·2 cm., an upper sheath 32 cm. tall with blade 35 by 4·5 cm.; culm-sheath ligule 8–10 mm. high throughout, incised more than half way to the base.

## RACEMOBAMBOS

**Racemobambos** Holttum in Gard. Bull. Singap. 15: 267. 1956.

Type species: *Bambusa gibbsiae* Stapf in Journ. Linn. Soc. Bot. 42: 189. 1914.

Spikelets in a *raceme* at the end of a leafy branchlet (fig. 34); lateral spikelets shortly stalked, in the axils of very small bracts, terminal spikelet on a longer stalk; each *spikelet* consisting of two empty glumes (the lower one usually very narrow), several perfect florets separated by rather long rachilla-internodes, and an imperfect terminal floret; *lodicules* usually 3, fringed with hairs; *stamens* 6, filaments free, anthers not apiculate; *ovary* small, cylindric, its hairy apex globose or ovoid, wider than the cylindric lower part; stigmas 3, slender, arising directly from the swollen apex of the ovary.

A genus of five known species, one from Gunong Pulai in Malaya and the others from the mountains of Borneo. The ovary is quite like that of some species of Bambusa, but the arrangement of the spikelets is quite different, resembling Arundinaria.

**R. setifera** Holtt. in Gard. Bull. Singap. 15: 271. 1956.

*Rhizome* sympodial, creeping, horizontal length between one culm and the next c. 10 cm., 5 mm. diameter, internodes 5-10 mm. long. *Culms* seen less than 10 mm. diameter, length not recorded, sheaths not known; leafy branches 20–25 cm. long, bearing 5–8 leaves and sometimes spikelets towards the apex, the spikelet-bearing part of the branch little longer than the last leaf-sheath. *Leaf-blades* 10–18 cm. long, 8–12 mm. wide, lower surface bearing scattered hairs 1 mm. long, stalk hardly 1 mm. long; auricles slightly raised, bearing slender bristles; ligule small. Axillary *spikelets* few, on stalks 2–3 mm. long; *lower glume* 6 mm. long, 1 mm. wide, 1-veined; *upper glume* 10 mm. long, 2·5 mm. wide, 9-veined, edges fringed, slightly keeled near apex but not apiculate; *rachilla-internode* between upper glume and first lemma 1·5 mm. long, between first and second lemmas 3 mm., remaining internodes 4·5 mm. long; *lemmas* 14–15 mm. long, edges fringed, apex setiform and 3 mm. long; *paleas* 10 mm. long, apex shortly bilobed, keels shortly fringed near the apex; *lodicules* 3 mm. long including a fringe of hairs 0·5 mm. long; *anthers* 5 mm. long; *ovary* proper 0·8 mm. long, the swollen apex narrowed upwards and 2 mm. long.

Distribution: Gunong Pulai, Johore; possibly also on the hills near Batu Pahat.

The only flowering specimen was collected by Best in G. Pulai (S.F.N. 7707, in Herb. Singap.). Ridley collected a sterile specimen of a slender climbing bamboo at a locality named Minyak Buku (no. 10991, S), apparently on one of the hills near Batu Pahat; this specimen agrees vegetatively with Best's so far as one can judge from leaves.

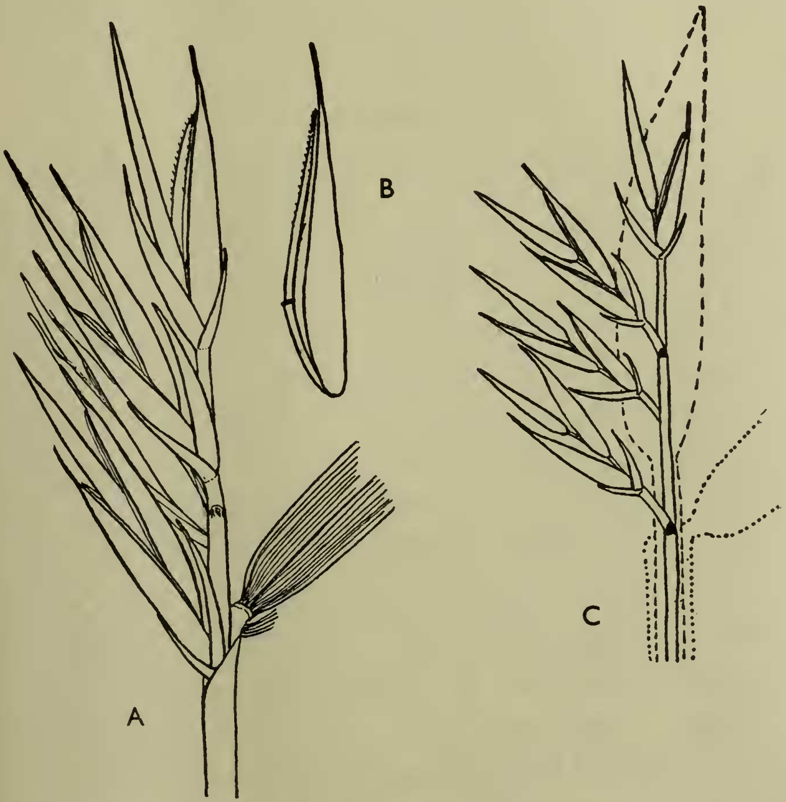

Fig. 34. *Racemobambos setifera*. A, a raceme of spikelets at the end of a leafy branchlet, with part of the last leaf, × 2½. B, one rachilla-internode bearing lemma and palea. C, diagrammatic interpretation of A, with stalks of spikelets and rachilla-internodes lengthened; outlines of last two leaves, and of their sheaths, dotted.